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Physics Abstracts

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Automatic control mechanisms	Thermionic tubes	Radiocommunication
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PHYSICS ABSTRACTS

Volume 59 MAY 1956 Number 701

MATHEMATICS 51

517.93

3435. A METHOD OF SOLVING MATHIEU'S EQUATION. J.J.Smith.
Trans. Amer. Inst. Elect. Engrs I, Vol. 74, 520-5 (1955) = Commun. and Electronics, No. 20 (Sept., 1955).

The infinite determinant arising in the classical solution of Mathieu's equation, is avoided by a new method involving the use of Green's function. This is used to form an integral equation from Mathieu's equation and the solution is then found by successive approximation. The solution is shown to agree well with certain experiments relating to oscillatory circuits with periodically varying parameters. The method described in this paper appears to offer possibilities for solving various non-linear differential equations. L.S.Goddard

518.5 : 621.374.32 : 681.142

3436. THE PROGRAMMING STRATEGY USED WITH THE MANCHESTER UNIVERSITY COMPUTER. R.A.Brooker.
Proc. Instn Elect. Engrs, Paper No. 2013 M, publ. March, 1956, 7 pp. To be republished in Vol. 103 B (1956).

The Mark I computer is a typical 2-level storage machine of which a brief description is included. The topics dealt with are: the method of storing and calling in routines; the representation of instructions outside the machine (tracing the reasons for the use of a teleprint or scale-of-32 code); the organization of the library of sub-routines; the mechanism of interpretive routines for double-length and floating-point operations; matrix operations; partial differential equations; an attempt at automatic programming; mistake diagnosis in programmes; and measures for dealing with machine breakdown. The basis of the strategy is considered in relation to the Mark II machine. A.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.035.33

3437. THEORY OF TRANSFER PROCESSES. E.P.Gross and S.Ziering.
Astrophys. J., Vol. 123, No. 2, 343-52 (March, 1956).

The method of half-range polynomials for transfer problems is studied. It is suitable in cases involving boundaries, where incoming and outgoing streams must be treated separately, Convergence is established for some simple problems of radiative transfer. The method is compared numerically with other approximations and with the exact solutions. Extremely accurate results are obtained in the lowest approximations. A.

523.11

3438. THE FORMATION OF SYSTEMS OF POSITIVE ENERGY. E.Schatzman.
C.R. Acad. Sci. (Paris), Vol. 242, No. 3, 346-7 (Jan. 16, 1956). In French.

Considering an expanding association of single, and double stars e.g. the system ζ Persei, the total energy of the system will be negative if account is taken of the negative energy of the individual double stars. Hence its formation by gravitational contraction appears feasible. D.R.Barber

523.161

3439. THE DISTRIBUTION OF INTERSTELLAR SODIUM AND CALCIUM. L.Spitzer, Jr and D.A.Lautman.
Astrophys. J., Vol. 123, No. 2, 363-6 (March, 1956).

Values of $N(Na^0)$ and $N(Ca^+)$, the numbers of neutral sodium and ionized calcium atoms in the line of sight, per square centimetre, have been determined from individual equivalent widths of the interstellar D1, D2, H and K lines, with appropriate saturation corrections for each star. Mean values of $\log N(Na^0)$ and $\log N(Ca^+)$ were then found for five distance groups and three ranges of colour excess, E_1. Results indicate that $N(Na^0)$ is about proportional to the colour excess, for E_1 less than 0.20, while $N(Ca^+)$ shows significantly less dependence on E_1. Thus the particle density of neutral sodium appears to be proportional to the corresponding density of grains, provided that this latter quantity is not too great. Ionized calcium appears less concentrated to the obscuring clouds, in agreement with previous indications, but the numerical results for Ca^+ are not entirely firm because of uncertainty in the saturation corrections. A.

523.164.32

3440. BRIGHTNESS DISTRIBUTION OF THE SUN AT 1.45 METERS. J.Firor.
Astrophys. J., Vol. 123, No. 2, 320-4 (March, 1956).

By using a variable-spacing interferometer receiving 1.45 m wavelength radiation, the quiet sun has been analysed with the interferometer fringes both parallel and perpendicular to the solar axis. The aerial spacing was varied in small steps up to about 175 wavelengths, and some measurements were made at up to 340 wavelengths. Phase measurements were made by calibrating the interferometer lobe positions on the strong radio sources in Cygnus and Taurus. The brightness distribution derived from these measurements necessarily contains uncertainties arising from the fact that the interferometer trace was not zero for the longest spacings used. However, two main features seem certain: (1) the sun at this wavelength has a bright limb, similar to that predicted theoretically, both at the equator and at the pole; and (2) the equatorial dimension of the sun is larger than the polar dimension. A.

523.164.34

3441. OBSERVATION OF A LUNAR ECLIPSE AT 1.5 MM. W.M.Sinton.
Astrophys. J., Vol. 123, No. 2, 325-30 (March, 1956).

Observations were made of a total lunar eclipse in a band of wavelengths at approximately 1.5 mm. It was found that the lunar emission decreased during the eclipse but that this decrease lagged about 1 hour behind the visual eclipse. To account for this lag, the 1.5 mm radiation is interpreted as

arising from levels beneath the surface of the moon. From this interpretation a mass-absorption coefficient of 2.9 $cm^2 g^{-1}$ has been determined for the surface of the moon. Measurements of the mass-absorption coefficient of pumice, basalt, obsidian and a stony meteorite are reported and compared to that of the moon. A.

523.66

3442. ON THE MECHANISM OF COMET OUTBURSTS AND THE CHEMICAL COMPOSITION OF COMETS. B.Donn and H.C.Urey.
Astrophys. J., Vol. 123, No. 2, 339-42 (March, 1956),

The authors propose that the more prominent comet activity arises from explosive chemical reactions involving free radicals or unstable molecules. This requires a modification of the icy-conglomerate comet model to include a mixture of both stable molecules and reactive species. Such a model is consistent with recent laboratory experiments on the behaviour of free radicals at low temperatures. A brief description of the possible course of the reaction, which could be triggered by solar-particle radiation, is given. Very high ejection velocities found according to mechanical theories of comet shapes would be difficult to account for. An observational test of the reaction hypothesis is suggested. A.

523.7

3443. PHYSICS OF THE SUN. Z.Kopal.
Brit. J. appl. Phys., Vol. 7, No. 4, 119-28 (April, 1956).

The first part of this paper reviews the fundamental observed data bearing on the physics of the Sun — in particular, its size, mass and luminosity. In the second part, an outline of the equilibrium model of solar interior is given. It is pointed out that the forces determining its structure are primarily gravitational, and that most of its interior is likely to be in radiative equilibrium. High internal temperature (attaining some 14×10^6 °K at the centre) brings about far-reaching ionization which, in turn, permits solar matter to behave like a perfect gas even at a central density of 90 g/cm^3, and causes part of the radiant energy leaking slowly outwards to have the nature of soft X-rays. The third part reviews the principal nuclear reactions capable of transforming hydrogen into helium under conditions which prevail in the solar interior, and whose exothermic nature provides the source of energy which causes the Sun to shine. It is pointed out that a high temperature-dependence of such reactions restricts the actual energy production essentially to central portions of the Sun; and high opacity of its internal matter is bound to keep this central thermonuclear reactor of the solar system burning at an exceedingly steady rate. The concluding section of the paper reviews the physics and chemistry of the solar visible surface and of its atmosphere. It is pointed out that most phenomena observed in these regions involve but minute transport of mass; but, unlike in the interior, the forces governing them are electromagnetic rather than gravitational. The survey ends with a brief description of the solar corona, whose physical structure is dominated by a temperature of the order of 10^6 °K. Dynamically the corona is a fleeting, unstable phenomenon constantly dissoving and being replenished; but the source of the energy necessary for the maintenance of so high a temperature remains one of the great unsolved puzzles of solar physics. A.

523.7 : 538.3 : 532.51 : 550.38

HYDROMAGNETIC ORIGIN OF SOLAR MAGNETIC FIELDS AND OTHER PHENOMENA: A REVIEW. See Abstr. 3383

523.745

3444. A PROMINENT CENTRE OF SOLAR ACTIVITY. M.Rigutti.
Mem. Soc. Astron. Ital., Vol. 26, No. 4, 549-54 (1955). In Italian.

The development of an activity centre observed on the solar disk between June 10 and Jun 23, 1955, is described on the basis of drawings made from the Hα spectroheliograms. Areas of prominences associated with the "centre" and areas of bright Hα and $K_{2,3}$ flocculi are given. A.

523.752

3445. A MODEL OF THE CHROMOSPHERE FROM THE HELIUM AND CONTINUUM EMISSIONS. R.G.Athay and D.H.Menzel.
Astrophys. J., Vol. 123, No. 2, 285-98 (March, 1956).

Helium-line emission observed in the flash spectrum at the Khartoum eclipse is interpreted in terms of a chromospheric model. The HeI triplets have excitation temperatures of about 6000°, and the singlets have excitation temperatures of about 20 000°. It is demonstrated that ultraviolet emission from the corona cannot account for the observed excitation of helium. A model of the chromosphere is derived from the helium data combined with the continuum data at λ 3640 and λ 4700. A two-column model, with T_e and n_e varying from column to column along a horizontal surface, is needed to satisfy the data. The model gives $T_e(h)$ and $n_e(h)$ in both types of columns. The cooler columns are identified with the spicules on the basis of the observed spicule structure on the spectrograms. A.

523.752

3446. TEMPERATURE GRADIENTS IN THE CHROMOSPHERE. R.G.Athay and R.N.Thomas.
Astrophys. J., Vol. 123, No. 2, 299-308 (March, 1956).

Earlier determinations by the authors of electron temperature, T_e, in the chromosphere by analysis of eclipse data are supplemented in this paper by considerations of the energy balance. They assume that T_e may have only those values for which there is thermal stability. If an increase in T_e, at a given height, results in an increase in the energy radiated, the model is stable. However, if an increase in T_e causes a decrease in the energy radiated, there is no stable value of T_e. Two regions of stability surmounted by regions of instability are recognized: (1) in the low chromosphere neutral hydrogen emission is stable and is the principal source of emission; (2) neutral hydrogen emission becomes unstable at a height where hydrogen becomes sufficiently ionized. At this height, T_e increases abruptly until stable emission from He II balances the energy input; (3) He II emission also becomes unstable at sufficient ionization, and T_e increases abruptly to a coronal value where either free-free emission or emission from multiply ionized metals predominates. Models of the chromosphere derived from 1952 eclipse data show good agreement with the conclusions based on thermal stability considerations. A.

523.752

3447. SOME CHARACTERISTICS OF A CHROMOSPHERIC MODEL. R.G.Athay and R.N.Thomas.
Astrophys. J., Vol. 123, No. 2, 309-19 (March, 1956).

Some general conditions that must be satisfied by a chromospheric model are discussed: (1) The available data on variations in chromospheric structure over the solar activity cycle indicate the highest emission gradients at sunspot maximum. (2) The evidence bearing on the choice of an energy or momentum perturbation as the chief characteristic of the low chromosphere is discussed, and a conclusion favouring the energy perturbation is reached. The maximum in the nonradiative energy input appears to lie near 500 km. (3) Some considerations on the effect of departures from spherical symmetry in the chromosphere are discussed in terms of hot versus cold spicules and of the thermodynamics of the resulting configurations. It is concluded, both from an a priori thermodynamic standpoint and from existing data, that the spicules must be cold. A.

523.76/.77

3448. THE DEPARTURE FROM THERMODYNAMIC EQUI-

LIBRIUM IN THE SOLAR CHROMOSPHERE (FOR LEVELS $n > 2$). C.Pecker and J.C.Pecker.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 994-7 (Feb. 20, 1956). In French.

To assess the non-Boltzmann distribution of atomic states, and to evaluate the saturation function, chromospheric data for the Balmer lines derived from the results of recent eclipse observations are used to construct models in which (a) all lines are Doppler broadened; (b) all lines are Stark broadened: and (c) Doppler broadening is effective for levels $n < 9$, and Stark broadening occurs when $n \geq 9$. Results are compared with those of Thomas, and Matsushima (1955). D.R.Barber

523.775 : 523.752 : 539.153

THE HIGH TEMPERATURE EXCITATION OF HELIUM. See Abstr. 3119

523.872

3449. THE WIDTHS OF THE LINES OF Fe, Si, O AND N IN THE SPECTRUM OF GAMMA PEGASI. E.Böhm-Vitense and O.Struve.
Astrophys. J., Vol. 123, No. 2, 228-30 (March, 1956).

The unblended lines of O II and N II in γ Pegasi are systematically broader than those of Si II, Si III, Si IV and especially Fe III. This phenomenon is explained in terms of thermal motions of the atoms. But there remains a number of abnormally broad lines whose half-widths cannot be accounted for by the present theory. A.

523.872

3450. OBSERVATIONAL CONFIRMATION OF A THEORY OF STELLAR EVOLUTION. H.L.Johnson and W.A.Hiltner.
Astrophys. J., Vol. 123, No. 2, 267-77 (March, 1956).

A "standard" main sequence for age zero has been computed from the observed Hyades, Praesepe, and Pleiades main sequences. The computations were made on the basis of a recent theory of stellar evolution. This "standard" main sequence turns out to be the lower envelope of the near-by stars in the colour-magnitude diagram. New distance moduli are given for three clusters. They were obtained by fitting the cluster main sequences to our standard main sequence. A comparison of the luminosities of the brighter cluster stars with the values for these same stars that were obtained from other investigations confirms the evolutionary corrections to the main sequence. A.

523.872

3451. ON THE MASS OF THE RR LYRAE STARS. A.Sandage.
Astrophys. J., Vol. 123, No. 2, 278-84 (March, 1956).

Recent work has indicated that the mass of the individual RR Lyrae stars in M3 is $M/M_\odot = 1.25$, as required by current ideas of stellar evolution, only if (1) $\bar{M}_{pv} = -0.43$ or (2) $P(\bar{\rho}/\bar{\rho}_\odot)^{1/2} = 0^d.055$ or (3) the RR Lyrae stars are bluer by $\Delta(B - V) = 0.11$ mag. than main-sequence stars of the same effective temperature. The third alternative is shown to be probably the case from a study of the change in the emergent flux from the stars as a function of surface gravity. The case for RR Lyrae itself is also discussed. It appears that RR Lyrae is reddened by about $\Delta(B - V) \cong 0.12$ mag. and that the considerations which are valid for the M3 variables apply also to RR Lyrae. A.

523.877

3452. THE CIRCUMSTELLAR ENVELOPE OF ALPHA HERCULIS. A.J.Deutsch.
Astrophys. J., Vol. 123, No. 2, 210-27 (March, 1956).

In the system of α Herculis, the M-type supergiant, and its visual companion, a giant G-type spectroscopic binary, are surrounded by a common circumstellar envelope. This envelope produces violet-displaced absorption cores in the zero-volt lines of the M star and stationary zero-volt absorption lines in the spectrum of the G star. The minimum radius of the envelope is 2×10^5 $R_\odot$; its minimum mass is probably about 1×10^5 $M_\odot$. It is condensed into clouds that fill only the fraction 10^{-7} of the whole spherical volume; within a condensation, the electron density is about 10^6 cm^{-3}. The envelope is expanding at a velocity of 10 km/sec; the matter in it has been ejected by the M star and is being lost to the system at a probable rate of at least 3×10^{-8} $M_\odot$/year. There is evidence for a comparable rate of mass loss from all other late-type supergiants. This process may be important in the evolution of all massive stars that have exhausted their hydrogen. A.

523.877

3453. A MICROPHOTOMETRIC STUDY OF THE SPECTRUM OF MAIA. S.-S.Huang and O.Struve.
Astrophys. J., Vol. 123, No. 2, 231-45 (March, 1956).

The chemical abundances in the atmosphere of Maia have been investigated. The temperature estimated from the strength of the helium lines and that from the Fe I and Fe II lines show an appreciable difference, as would be expected from Struve's hypothesis that the star is seen pole-on. A.

PHYSICS 53

53.084 : 537

3454. PRECISION FOR A PITTANCE. W.C.Michels.
Amer. J. Phys., Vol. 24, No. 3, 166-9 (March, 1956).

Apparatus consisting of two precision potential dividers, a student's galvanometer, a cheap standard cell, a table radio receiver, and a pair of intermediate frequency transformers is shown to be sufficiently flexible and sufficiently precise to allow it to be used for a large part of the electrical calibrations needed in a laboratory. Accuracies of about $\frac{1}{4}$ to 1% at zero frequency and of about 1% at 455 kilocycles per second can be obtained. The total cost of the equipment is $125 or less. A.

53.084 : 539.15/.17 : 621.375.221

3455. WIDE-BAND AMPLIFIERS IN NUCLEAR PHYSICS. A.Roumegous.
Portugal. Phys., Vol. 3, No. 3-4, 149-70 (1954). In French.

It is shown how the bandwidth of conventional amplifiers is limited by coupling and parasitic capacitances and how a correcting inductance improves matters. The calculations are shown both for the steady-state and transient regime. The alternative approaches to the problem of broad-banding, viz. feedback and distributed amplification are described.

S.C.Dunn

FUNDAMENTALS 530.1

530.12

3456. ON THE "BIANCHI IDENTITIES" OF THE EINSTEIN—SCHRÖDINGER UNIFIED THEORY. J.Winogradzki.
C.R. Acad. Sci. (Paris), Vol. 242, No. 1, 74-6 (Jan. 4, 1956). In French.

530.12

3457. ON THE APPROXIMATE EQUATIONS OF THE

EINSTEIN–SCHRÖDINGER UNIFIED THEORY. Pham Tan Hoang.
C.R. Acad. Sci. (Paris), Vol. 242, No. 6, 738-40 (Feb. 6, 1956). In French.

Approximate equations are obtained in terms of the symmetric and antisymmetric fields $b^{\mu\nu} = kh^{\mu\nu}$ and $q^{\mu\nu} = kf^{\mu\nu}$, with $k = \sqrt{(h/g)}$ and $g^{\mu\nu} = h^{\mu\nu} + f^{\mu\nu}$, assuming that $q^{\mu\nu}$ may be expanded in the form $\epsilon q_1^{\mu\nu} + \epsilon^2 q_2^{\mu\nu} + \ldots$ R.A.Newing

530.12

3458. RELATIVISTIC MECHANICS OF MATERIAL POINTS WITH VARIABLE MASS. N.S.Kalitsin.
C.R. Acad. Bulg. Sci., Vol. 7, No. 2, 9-12 (April-June, July-Sept., 1954). In Russian.

The equation $d/dt\{(1 - v^2/c^2)^{\frac{1}{2}} m\vec{v}\} - (1 - a^2/c^2)^{-\frac{1}{2}} \times (dm/dt)\vec{a} = \vec{F}$ is established, $\vec{a}$ being the velocity of the mass increment δ m. It is suggested that the equation may have application in rocket propulsion theory when the ejected particles have relativistic speeds. R.A.Newing

530.12

3459. THE RATIO OF GRAVITATIONAL TO KINETIC MASS FOR THE CONSTITUENTS OF MATTER. A.H.Wapstra and G.J.Nijgh.
Physica, Vol. 21, No. 10, 796-8 (Oct., 1955).

An analysis of the experiments of Eötvös about the ratio of gravitational to kinetic mass of a few substances yields the result that this ratio for the hydrogen atom, and for the binding energies are equal to that for the neutron with a precision of one part in at least 5×10^5, and 10^4 respectively. No conclusion can be drawn about these ratios for the proton and the electron separately. A.

530.12

3460. ON STATIC SOLUTIONS OF EINSTEIN'S GENERALIZED THEORY OF GRAVITATION. II. M.Ikeda.
Progr. theor. Phys., Vol. 13, No. 3, 265-75 (March, 1955).

For Pt. I, see Abstr. 706 (1955). On the basis of a new expression of the electromagnetic field strength considered in Pt. I, static solutions of the field equations for the magnetic case are studied. First a magnetostatic field is studied by introducing a scalar potential. Next, examining the feature of the field equations in Einstein's new theory, it is shown that a singularity of the field cannot be identified with the source, contrary to the classical field theories. By using this result it is further shown that a single magnetic pole does not exist. This conclusion is not contradictory to the observation, and consequently is favourable to Einstein's new theory. A.

530.12

3461. ON JORDAN'S THEORY OF THE CREATION OF MATTER. G.Ludwig and K.Just.
Z. Phys., Vol. 143, No. 4, 472-6 (1955). In German.

Variation principles previously considered (Abstr. 7669/1955) give equations of the form

$$T^{\alpha}_{\beta||\alpha} + (1 + c)\,\sigma_{|\alpha}\,T^{\alpha}_{\beta} + \tfrac{1}{2}\,\sigma_{|\beta}\,b = 0$$

for the energy tensor T^{α}_{β}, and the conditions $|b| \ll |T|$ and $|s| \gg c^2$ have been imposed. It is now found possible to take $c = -1$ and $s = 3/2$ provided the scalar b is set equal to T. The new conditions are introduced to allow for the possibility of the quantization of the material field, and from considerations of mathematical simplicity: in the 5-dimensional formulation, the spur of the matter tensor is now zero. The gravitational coefficient κ is constant for static fields, and the theory reduces to general relativity. In the non-static case the field equations imply the creation of matter. R.A.Newing

530.12 : 523.11

3462. THE BEHAVIOUR OF THE UNIVERSE. D.E.Littlewood.
Proc. Cambridge Phil. Soc., Vol. 52, Pt 1, 88-96 (1956).

The author's method of conformal transformations (Abstr. 4585/1953) is used together with the restricted cosmological principle to produce the known model universe of general relativity. R.A.Newing

530.12 : 523.112

3463. AXIALLY SYMMETRIC SOLUTION IN PROBLEMS OF GALACTIC MAGNETIC FIELDS AND A NEW TYPE OF RED SHIFT. R.L.Brahmachary.
Nuovo Cimento (Ser. 10), Vol. 2, No. 4, 850-3 (Oct., 1955).

A previous solution (Abstr. 6725/1955) for a monopole in expanding space is replaced by that for a magnetic dipole. The new red shift is stated to arise from the dependence of g_{44} on time. R.A.Newing

530.12 : 530.145

3464. PARTICLES OF VERY GREAT VELOCITIES IN SPINOR MECHANICS. A.Proca.
Nuovo Cimento (Ser. 10), Vol. 2, No. 5, 962-71 (Nov., 1955). In French.

In the author's classical theory (Abstr. 5264/1954), it is shown that the rest mass of a particle moving with the velocity of light is necessarily zero and that the 4-component spinor associated with the motion reduces to a constant spinor g of which only two components are independent. The theory then gives a whole family of particles moving with the velocity of light, physical magnitudes associated with a particle depending on two arbitrary complex parameters. R.A.Newing

530.12 : 530.145

3465. INTERFERENCE IN SPINOR MECHANICS. A.Proca.
Nuovo Cimento (Ser. 10), Vol. 2, No. 5, 972-9 (Nov., 1955). In French.

The author's mechanics is extended to include interference phenomena by associating with the particle a periodic spinor field. In the case of non-zero rest mass, the spinor field for a freely moving particle is $X = a_1\exp(ir_\rho x^\rho) + b_1\exp(-ir_\rho x^\rho)$, where x^ρ is the space-time position vector, r_ρ is proportional to the 4-vector momentum and a_1, b_1 are constant 4-component spinors. X reduces to the spinor ξ along the trajectory of the particle, and space-time fields associated with the particle are of the form X^+AX, where A is a space-time vector or tensor. In the case of zero rest mass, the X-field is not uniquely defined but a simple choice gives a reasonable representation of the photon field. R.A.Newing

530.12 : 538.3

3466. ON THE ELECTROMAGNETIC EQUATIONS IN MATTER. Pham Mau Quan.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 465-7 (Jan. 23, 1956). In French.

The field equations for an electromagnetic fluid-field system (Abstr. 4342/1955) are used to show that photon trajectories can be represented as null geodesics in the 4-space defined by the metric $\gamma_{\alpha\beta} = g_{\alpha\beta} - [1 - (1/\lambda\mu)]\,u_\alpha u_\beta$, where λ and μ are the dielectric constant and magnetic permeability, and u_α is the world velocity of the medium at the point considered. R.A.Newing

530.12 : 538.3 : 621.3.011

3467. PHYSICAL LAWS OF ELECTROMAGNETISM IN THE LIGHT OF THE TRANSFORMATIONS OF MOTION. J.Vavřín.
Elektrotech. Obzor, Vol. 43, No. 10, 521-6 (1954). In Czech.

The change of values in an electromagnetic field which takes place in transition from the Galilei transformation to the Lorentz one, is important for the evaluation of error made in the former. The difference in results derived from both these transformations is only noticeable in magnitudes of the second order. It is also shown that the e.m.f. induced in a loop is always equal to the negative time differential of the total flux irrespective of the nature of motion imparted to any portion of the winding. J.C.Stark

530.145

3468. ON THE HYPOTHESIS OF RANDOM A PRIORI PHASES AND THE TRANSITION PROBABILITY CONCEPT. J.Seiden.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 454-7 (Jan. 23, 1956). In French.

Discusses the applicability of these concepts to the calculation of the irreversible exchange of energy between coupled quantum-mechanical systems. E.H.Sondheimer

530.145

3469. DEDUCTION OF QUANTUM THEORY FROM EXTRA-QUANTUM THEORETICAL PRINCIPLES. A.Landé.
J. Phys. Radium, Vol. 17, No. 1, 1-4 (Jan., 1956). In French.

An attempt to deduce some of the principles of quantum mechanics from a certain method of avoiding the well-known Gibbs paradox, and the hypothesised existence of transition probabilities (see Abstr. 6726/1955). P.T.Landsberg

530.145

3470. NUMBER OF FEYNMAN GRAPHS AND CONVERGENCE. E.R.Caianiello.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 223-5 (Jan., 1956).

Arguments have been given, based on the number of graphs, that the perturbation series is at best asymptotic. It is shown by means of a counter example that these arguments are inconclusive. P.T.Matthews

530.145

3471. THE RELATION BETWEEN JORDAN'S NON-LOCALIZED THEORY AND PAIS—UHLENBECK'S THEORY. Y.Miyatake.
Progr. theor. Phys., Vol. 13, No. 4, 458-9 (April, 1955).

If the restriction, that no action may travel faster than light, is lifted, then Jordan's non-local theory (Abstr. 7446/1953) comes into the category of exponential theories of Pais and Uhlenbeck, shown by them to lack the propagation character. This suggests that the loss of propagation character for such theories is due to the violation of the above restriction.
P.T.Matthews

530.145

3472. EINSTEIN'S POSTULATE CONCERNING THE PROPAGATION OF SIGNALS AND THE 4-SPACE GREEN FUNCTIONS OF THE QUANTUM THEORY OF FIELDS. O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 241, No. 25, 1921-2 (Dec. 19, 1955). In French.

530.145

3473. DIFFRACTION BY A PLANE HOLE OF ARBITRARY SHAPE. GENERAL FORMULAE. O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 242, No. 3, 347-50 (Jan. 16, 1956). In French.

A rigorous method, based on wave mechanics, is presented for analysing the diffraction. It amplifies the method proposed earlier (Abstr. 3418/1955) and extends to four dimensions the general formulae of the classical theory of diffraction. L.S.Goddard

530.145

3474. DIFFRACTION BY A PLANE HOLE OF ARBITRARY SHAPE. PHYSICAL INTERPRETATION OF A PRECEDING FORMULA. O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 467-70 (Jan. 23, 1956). In French.

A continuation of a previous paper (preceding abstract). Symmetric problems of prediction and its inverse are discussed. The generalized diffusion of Feynman (Abstr. 243, 2187/1950) is used. Homogeneity between the second, third and fourth uncertainty relations is also studied. L.S.Goddard

530.145

3475. ON AN EXPLICIT COVARIANT FORMULATION OF SECOND QUANTIZATION. R.Potier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 470-3 (Jan. 23, 1956). In French.

The ideas of Costa de Beauregard (preceding abstracts) are used to develop a new formulation of second quantization.
L.S.Goddard

530.145

3476. QUANTIZED FIELD THEORY IN THE HAMILTON-JACOBI FORMALISM. H.Freistadt.
Phys. Rev., Vol. 102, No. 1, 274-8 (April 1, 1956).

A method is developed, and applied to the free Klein-Gordon field, for modifying the author's Hamilton-Jacobi formalism for classical field theory in such a way as to describe field quantization. Although the modified Hamilton-Jacobi equations, as well as the explicit, modified, nonlinear field equations do not contain functionals of the field variables on a space-like surface, but only functions of the field variables at a space-time point, they are implicitly tied to families of space-like surfaces through a normal vector field which cannot be eliminated. Further, the modified Hamilton-Jacobi equations in each case can be found only from the Schrödinger equation for the quantized field system, not directly by a uniform method of generalizing the classical equations. The consistency of the present method with the usual formalism of field quantization is shown by means of a continuity equation, but no explicit solutions, which would exhibit the presence of particle-like quanta, are given. Problems peculiar to fermions are not discussed. A.

530.145

3477. ON THE THEORY OF ELEMENTARY PARTICLES. III. QUANTUM FIELD THEORY OF NUCLEONS OF FINITE EXTENSION. G.Heber.
Z. Phys., Vol. 144, No. 1-3, 39-55 (1956). In German.

For Pt I, see Abstr. 8497 (1955); Pt II in press. The attempt is made to quantize a non-linear, non-relativistic field theory in such a way that it can describe elementary particles of finite extension. The suggested method is related to the quantization of lattice spaces and to non-local field theories. The Schrödinger equations for one and two particles are turned into difference equations corresponding to linear integral equations. The theory incorporates the previously suggested classical field-theoretical model of the nucleon (Abstr. 4369-70/1955). G.Field

530.145

3478. THE FORM OF THE DIVERGENCIES IN QUANTUM ELECTRODYNAMICS. J.C.Taylor.
Proc. Roy. Soc. A, Vol. 234, 296-300 (Feb. 7, 1956).

The results of Landau and his collaborators on the asymptotic form of the propagators for high energies and the dependence of the renormalization constants on the cut-off are rederived, starting from the functional equations of Gell-Mann & Low. It is proved further that, in electrodynamics, the cut-off cannot be made arbitrarily large, without the 'bare-particle' charge becoming imaginary. A.

530.145

3479. MANY-BODY PROBLEM IN QUANTUM FIELD. III. K.Nishijima.
Progr. theor. Phys., Vol. 13, No. 3, 305-28 (March, 1955).

The general procedures described in Pts. I and II (Abstr. 5305/1954; 3428/1955) to deal with the scattering problems involving composite particles are illustrated in this paper for the interacting scalar meson and scalar photon fields. Utilizing Wick's solution for the covariant two-body equation (Bethe—Salpeter equation), the following problems are discussed: (1) the normalization of the Feynman amplitude for the bound state corresponding to Wick's solution, (2) the disintegration of the bound state by a scalar photon, (3) the Rutherford scattering of the composite particle. In appendices some general remarks are given on the reciprocal nature of the present formalism and on the asymptotic forms of the Feynman amplitudes.
A.

530.145

3480. NOTE ON THE BOUND STATE PROBLEM. T.Okabayashi.
Progr. theor. Phys., Vol. 13, No. 3, 338-40 (March, 1955).

A method is proposed for constructing formally the state vectors for bound states, starting from the non-interacting system, and to determine binding energies. W.A.Hepner

530.145

3481. SOME REMARKS ON LEE'S MODEL IN RENORMALIZABLE FIELD THEORY. Y.Munakata.
Progr. theor. Phys., Vol. 13, No. 4, 455-7 (April, 1955).

It is remarked that the second pole in the V-particle propagator in Lee's model (Abstr. 9936/1954) is unphysical since the mass tends to minus infinity as the coupling constant tends to zero. Also the non-local nature of the model inhibits a relativistic generalization. P.T.Matthews

530.145

3482. INFELD FACTORIZATION AND ANGULAR MOMENTUM. H.R.Coish.
Canad. J. Phys., Vol. 34, No. 4, 343-9 (April, 1956).

The connection between Infeld factorization operators and angular momentum operators, well known for spherical harmonics, is extended to other factorization problems by explicitly recognizing them as angular momentum problems. These other problems are: the symmetric top, electron-magnetic pole system, Weyl's spherical harmonics with spin, free particle on a hypersphere. The Kepler problem is also included for it may be thrown into the form of a four-dimensional angular momentum problem. The transformation to momentum space for this problem is very much simplified by the connection between Infeld factorization and angular momentum. A.

530.145

3483. VELOCITY OF THE DIRAC ELECTRON. Z.Koba.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 1-5 (Jan., 1956).

Dirac's simple argument concerning the velocity eigenvalues of a relativistic electron is modified, taking into account the essential role played by anti-particle states. A.

530.145

3484. ON A BILOCAL INTERPRETATION OF ISOTOPIC SPIN. J.Rayski.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 126-30 (Jan., 1956).

The systematization of elementary particles by Gell-Mann and the author are complementary. Arguments against the existence of an isotopic spin space are given. The isotopic spin seems to be explicable within the framework of the bilocal field theory without necessity of increasing the number of dimensions of the physical space. A.

530.145

3485. APPLICATION OF THE VARIATIONAL METHOD TO THE CALCULATION OF PROTON–PROTON SCATTERING IN THE REGION 0-5 MeV. S.Skavlem and I.Espe.
Ark. Fys., Vol.10, Paper 8, 89-96 (1955).

Gives a calculation of the proton–proton scattering on the basis of a Yukawa potential, corresponding to meson masses 300 m_e, 370 m_e and 400 m_e, respectively. The best fit with recent scattering experiments is obtained with a meson mass of 334 m_e. A simple explicit expression for the proton–proton S-wave function is worked out. The nuclear scattering phase shift and the S-wave function are both expanded in powers of k^2, the square of the relative wave number, and only two terms in these expansions are taken into account in the present work. A.

530.145

3486. ON THE ELECTROMAGNETIC PROPERTIES OF THE DEUTERON. M.Sugawara.
Ark. Fys., Vol. 10, Paper 11, 113-28 (1955).

The exchange current corrections to the quadrupole and magnetic moments of the deuteron have been calculated, assuming the sym. p s-p s meson theory and employing T-D formalism, neglecting the nucleon recoil energy in the energy denominator and retaining only the one meson amplitude. Also the non-additivity and the relativistic corrections have been estimated in the same approximation. It is shown that the exchange correction of the magnetic moment is fairly unambiguous and is estimated as −0.85% of its empirical value, while that of the quadrupole moment is somewhat ambiguous and may be estimated as from +2% to zero or even a small negative value of its empirical value. The non-additivity and the relativistic corrections are estimated as +0.26% and −0.41%, respectively. The latter two effects ar uncertain but almost cancel each other; thus the final estimate of the magnetic moment correction is fairly definite and is $-1.0 \pm 0.3\%$. This correction, in turn, determines the D-state probability as $2.4 \pm 0.5\%$. Including the overall errors, the final estimate of the D-state probability is $3 \pm 1\%$, a definitely smaller value than 4%. A.

530.145

3487. NOTES ON A VARIATIONAL METHOD IN THE DEUTERON PROBLEM. K.V.Laurikainen.
Ann. Acad. Sci. Fennicae AI, Paper 208, 7 pp. (1955).

Euranto and the present author have developed a variational procedure in an eigenvalue problem met with when examining the ground state of the deuteron in the case of tensor forces. A short report of this method is given here and a comparison is made between numerical results, obtained when using an improved trial function, and those of Feshbach and Schwinger. A

530.145

3488. CONTRIBUTIONS TO THE NUMERICAL TREATMENT OF THE DEUTERON PROBLEM. K.V.Laurikainen and E.K.Euranto.
Ann. Univ. Turku.A, Vol. 18, No. 2, 21 pp. (1955).

A general scheme for a variational treatment of two coupled Sturm–Liouville equations has been presented and applied to the system determining the ground state of the deuteron in the nonrelativistic static approximation of the symmetrical pseudoscalar meson theory. The divergency at x = 0 has been "cut off" by replacing the tensor potential by the less singular expression

$$(e^{-x}/x)[1 + 3\{(1 - e^{-\beta x})/x\} + 3\{(1 - e^{-\beta x})/x\}^2],$$

where β is a cut-off parameter. The actual tensor potential is obtained in the limiting case $\beta = \infty$. Some numerical results are given. A.

530.145

3489. ELECTROMAGNETIC PROPERTIES OF DEUTERON. I.Sato and K.Itabashi.
Progr. theor. Phys., Vol. 13, No. 4, 341-59 (April, 1955).

The meson corrections to the magnetic dipole and electric quadrupole moments of a deuteron are calculated in the pseudoscalar meson theory with pseudovector coupling. These moments are expressed in the form $(\chi, U\chi)$, where χ is the Tamm Dancoff amplitude for the deuteron, and U is the modified interaction operator between nucleons and an external electromagnetic field. U and normalization of χ are calculated to the fourth order in coupling constant. Renormalizations of nucleon mass and coupling constant are performed non-relativistically. Numerical values of χ are taken from the paper of Brueckner and Watson (1953). For the magnetic moment, only the expression is given. For the electric quadrupole moment, the correction to the value of Brueckner and Watson 2.83×10^{-27} cm^2 is found to be 0.285×10^{-27} cm^2. The previous calculations of Villars (1952) and Deser (1953) are criticized briefly. A.

530.145

3490. ON THE INTERPRETATION OF THE INTERACTION OF LOW-ENERGY π-MESONS. W.Thirring.
Helv. phys. Acta, Vol. 28, No. 5-6, 591-616 (1955). In German.

Simple consequences of the parity, spin and coupling constant of the π-mesons are discussed in a semi-classical fashion, and the order of magnitude of various elementary processes is estimated. The differences between meson theory and quantum electrodynamics are discussed and renormalization is touched upon. G.E.Brown

530.145

3491. THE NATURE OF YUKAWA POTENTIAL. K.C.Kar and D.Roy.
Indian J. theor. Phys., Vol. 2, No. 4, 159-66 (Jan., 1955).

It is shown that the short-range Yukawa potential is of electrical origin, being due to polarization of the nucleons at close distance. It is further shown that for two spinning nucleons at close distance the general interaction energy should be $W = -g^2(e^{-kr}/r) + [\mu_2 \mathrm{rot}_2 \mathrm{rot}_1\{(\mu_1/r)e^{-kr}\}]$ as taken by Kar and Mukherjee (Abstr. 5298/1954, 2425/1955). A.

530.145

3492. ON A SIMPLE DEDUCTION OF LOW'S EQUATIONS IN THE FORMALISM OF LEHMANN, SYMANZIK AND ZIMMERMANN. F.Duimio, P.Gulmanelli and A.Scotti.
Nuovo Cimento (Ser. 10), Vol. 2, No. 5, 1132-4 (Nov., 1955). In Italian.

Shows how integral equations of Low's type (Abstr. 3453/1955) for meson-nucleon scattering can be derived within the scheme developed by Lehmann et al. (Abstr. 1510/1955). J.M.Radcliffe

530.145

3493. THE DETERMINATION OF THE SCATTERING POTENTIAL FROM THE SPECTRAL MEASURE FUNCTION. II. POINT EIGENVALUES AND PROPER EIGENFUNCTIONS. I.Kay and H.E.Moses.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 66-84 (Jan., 1956).

Pt I (Abstr. 2662/1956) was restricted to the consideration of weight operators which led to Hamiltonians H whose spectra were identical with the spectrum of a given unperturbed Hamiltonian H_0. In this part the authors aim to show how one may choose weight operators which lead to Hamiltonians H having spectra different from that of H_0. To make the discussion more concrete they take the case where H_0 has a purely continuous spectrum extending from 0 to ∞ and where H has a spectrum which has a continuous part which coincides with the spectrum of H_0 and, in addition, has negative point eigenvalues. A.

530.145

3494. A REALISTIC THEORY OF MESONS. B.Jouvet.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 4, 941-68 (1955).

It is claimed that the Yukawa theory of nuclear forces and the Fermi theory of beta decay may be unified by postulating a Fermi coupling between various pairs of fermions. After regularizing in a certain way, the summation of certain terms in the S matrix is equivalent to virtual mesons, whose masses and coupling constants with various fermion pairs may be expressed in terms of the properties of the fermions only. P.T.Matthews

530.145

3495. Λ^0 BINDING IN LIGHT NUCLEI. G.Wentzel.
Phys. Rev., Vol. 101, No. 2, 835-7 (Jan. 15, 1956).

In an attempt to study the forces by which the hyperon Λ^0 is bound in light hyperfragments, several assumptions are made: (1) perturbation theory is adequate; (2) vertices like $N - \Lambda^0 + \theta^0$ are dominant; (3) the spin of the θ is 0 or 1, and the spin of the Λ is $\frac{1}{2}$ or $\frac{3}{2}$; (4) there are no attractive contact potentials; (5) Λ- nucleon forces are much weaker than nucleon—nucleon forces. If these assumptions are granted, the trend of the binding energy of the Λ as a function of the mass number can be predicted for each coupling type. Certain assignments of spin and parity $(s_\Lambda, s_\theta) = (\frac{1}{2}^+, 0^+)$, $(\frac{1}{2}^-, 1^-)$ and $(\frac{3}{2}^-, 1^-)$ can be ruled out, because in these cases a Λ cannot be bound by H^3, He^3, or heavier nuclei, contrary to experimental findings. A.

530.145

3496. NUCLEON-NUCLEON POTENTIAL WITH RELATIVISTIC CUTOFF. H.P.Noyes and S.P.Pandya.
Phys. Rev., Vol. 102, No. 1, 269 (April 1, 1956).

A nucleon-nucleon potential which is a well-defined static limit of a phenomenological covariant interaction, with correct qualitative features required by scattering phenomena, is suggested. A.

530.145

3497. DETERMINATION OF THE POTENTIAL FROM SCATTERING DATA. J.B.Keller, I.Kay and J.Shmoys.
Phys. Rev., Vol. 102, No. 2, 557-9 (April 15, 1956).

It is shown that in classical mechanics a spherically symmetric repulsive potential can be determined from the differential scattering cross-section for particles of a single energy E. The potential is determined explicitly, but only outside the radius of closest approach at energy E. Higher energies are required to probe closer to the centre. The results are compared with related quantum mechanical results. A.

530.145

3498. CALCULATION OF THE SCATTERING POTENTIAL FROM REFLECTION COEFFICIENTS. H.E.Moses.
Phys. Rev., Vol. 102, No. 2, 559-67 (April 15, 1956).

It is shown how the scattering potential can be calculated from suitably defined reflection coefficients in the case of the one- and three-dimensional reduced wave equations by means of a formal series expansion. The more general problem of calculating scattering potentials from elements of the scattering operator is also discussed and it is shown that to calculate the scattering potential it is often sufficient to prescribe the representation in which it is to be diagonal. A.

530.145

3499. FORMULA FOR DIFFERENTIAL CROSS SECTION IN NUCLEON—NUCLEON SCATTERING. M.Matsumoto.
Progr. theor. Phys., Vol. 13, No. 3, 329-34 (March, 1955).

A formula is given in terms of phase shifts taking into account partial waves of angular momentum $J \leq 3$. G.E.Brown

530.145

3500. THE ERGODIC THEOREM IN QUANTUM MECHANICS. M.Fierz.
Helv. phys. Acta, Vol. 28, No. 7, 705-15 (1955). In German.

It is suggested that v. Neumann's assumption about the even distribution of macroscopic observers be replaced by one about the microscopic perturbations of the system. W.A.Hepner

530.145

3501. THE DIFFERENTIAL-SPACE THEORY OF QUANTUM SYSTEMS. N.Wiener and A.Siegel.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 4, 982-1003 (1955).

Referring to the authors' previous work, definitions and postulates of a hidden-parameter type of theory are propounded in an attempt to support Einstein's view on the physical interpretation of quantum mechanics. However, in its present provisional form, this does not in any sense constitute a refutation of Bohr's point of view. W.A.Hepner

530.145

3502. REARRANGEMENT COLLISIONS. B.A.Lippmann.
Phys. Rev., Vol. 102, No. 1, 264-8 (April 1, 1956).

The quantum-mechanical theory of rearrangement collisions is discussed, in particular: (a) the transformation of the state vector from the original basis to the basis of the rearranged system; (b) the conditions for the equivalence of the "post" and "prior" interactions when computing matrix elements; and, (c) the extension of Schwinger's variational principle to rearrangement collisions. A.

530.16

3503. THE GENERAL STATISTICAL PROBLEM IN PHYSICS AND THE THEORY OF PROBABILITY. D.Bohm and W.Schüttzer.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 4, 1004-47 (1955).

It is usually held that any statistical theory in physics must rest eventually on a probability hypothesis. It is argued here that this view is wrong or, at best, somewhat limiting. For example, a uniform probability distribution over the energy shell in phase space is a sufficient but not necessary condition for the validity of Maxwell's distribution law; any continuous distribution would do just as well. The essential physical fact here is the existence of a 'statistical relationship' which does not depend on detailed knowledge of the system. Further examples (especially a model case of uniform distribution in phase arising from the determinate sequence $\theta_{n+1} = K\theta_n \pmod{2\pi}$, K an integer) are discussed at length; there are also comments on the foundations of probability theory and the meaning of 'randomness'. R.O.Davies

530.162

3504. MARKOFF CHAINS IN ABSTRACT SETS AND APPLICATIONS TO PROCESSES WITH ABSORBING REGIONS AND TO THE PROBLEM OF 'BUCKLES'. D.van Dantzig.
Ann. Inst. Poincaré, Vol. 14, No. 3, 145-99 (1955). In French.

A new method, using generalized generating functions and matrices, is introduced and applied to obtain a generalization of Wald's fundamental identity. The 'buckles' referred to in the title are portions of a Markoff chain returning to their starting point. The treatment of the problem is general, rigorous and thorough. N.L.Johnson

530.162

3505. EXTENDED INTERPRETATION OF THE BOLTZMANN–MAXWELL EQUATION (A THEORY OF NONSTATIONARY RANDOM PROCESSES). T.Koga.
J. chem. Phys., Vol. 23, No. 12, 2275-81 (Dec., 1955).

Usual theories of statistical mechanics of nonuniform state stand on the assumption of approximately stationary random processes. Generally speaking, this assumption is not reasonable when the state concerned deviates considerably from thermal equilibrium. For a system in such a state, it is difficult not only to define but also to observe a complete set of gross variables. In this case the deviations of the actual future values of the gross variables from their expected future values cannot be neglected. A new method of coarse-graining is proposed as available to such a state. As a concrete example of the system a gas is taken. A coarse-grained function $\langle f \rangle_D$ by averaging the fine-grained probability function of one molecule over a series of observations made on the system on different occasions where at each observation the system is initially in a common macroscopic state as determined by the incomplete set of initial conditions. It is shown that $\langle f \rangle_D$ satisfies the Boltzmann–Maxwell equation. The equation is valid even when the state concerned deviates considerably from thermal equilibrium and the random processes are not stationary. In this situation, however, the interpretation of the equation is different from the usual one; i.e., the equation predicts not the result of an individual observation of the gas concerned but the result obtained by averaging over a series of observations made repeatedly on different occasions on the same gas under a common incomplete set of macroscopic initial conditions where, with the lapse of time from the start, the result of each observation deviates from the others even in the macroscopic sense. For the time being, the theory is given only in the sense of classical mechanics. A.

530.162 : 519.2

3506. APPROXIMATE JOINT PROBABILITY DISTRIBUTION FOR WAVE AMPLITUDE AND FREQUENCY IN RANDOM NOISE. R.A.Wooding.
Nature (London), Vol. 176, 564-5 (Sept. 17, 1955).

Obtains the joint distribution of the 'normalized' angular velocity α and the 'normalized' envelope amplitude z in the form $2\pi^{-1/2} z^2 \exp[-z^2(1+\alpha^2)]\, d\alpha dz$. For narrow spectra, it is stated, the angular velocity will be closely related to the 'instantaneous' frequency. N.L.Johnson

530.162 : 536.7

3507. ON THE QUANTUM THEORETICAL DERIVATION O CLASSICAL PHYSICS. II. STATISTICAL MECHANICS AND THERMODYNAMICS. H.Kümmel.
Nuovo Cimento (Ser. 10), Vol. 2, No. 5, 877-97 (Nov., 1955) In German.

The considerations of Pt I (Abstr. 7733/1955) are extende to statistical mechanics and thermodynamics. W.A.Hepne

530.162 : 541.124

3508. BROWNIAN MOTION IN A FIELD OF FORCE AND THE DIFFUSION THEORY OF CHEMICAL REACTIONS. II. H.C.Brinkman.
Physica, Vol. 22, No. 3, 149-55 (March, 1956).

In a previous paper (Abstr. 2701/1956) the author gave a solution of Kramers' diffusion equation in phase space by systematic development. In this paper the general problem of the shuttling forward and back of a particle between two potential holes is studied. It is found that the reaction rates depend exponentially on the ratio of activation energy to kT. This remains true for a reaction proceeding simultaneously in both directions. The form of temperature dependence of the non-exponential factor is determined by the potential curve. Analogous results are obtained for a system containing many degrees of freedom. A

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.221

3509. APPLICATION OF DIRAC'S δ-FUNCTION IN ISOLATED-FORCE PROBLEMS OF THE THEORY OF ELASTICITY. I. G.R.Verma.
Indian J. theor. Phys., Vol. 2, No. 4, 167-74 (Jan., 1955).

Problems of isolated forces acting on the straight boundar of a semi-infinite plate, composed of isotropic or non-isotrop material have been solved by using Dirac's δ-function. The method is found very useful specially when there are a large number of forces acting on the boundary. A.

531.258 : 535.55

3510. SINGULAR POINTS IN PLANE ELASTICITY. G.Sale
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 449-50 (Jan. 23, 1956). In French.

A theoretical discussion is given of the appearance of the orthogonal network of the isostatic curves near points where the two principal constraints are equal. The theory shows that similar results can be observed in plates cut for three dimensional work. H.G.Jerrard

531.258 : 539.313

3511. STRESS DEFORMATION RELATIONS FOR SOLIDS. J.L.Ericksen.
Canad. J. Phys., Vol. 34, No. 2, 226-7 (Feb., 1956).

Using the theory of Pfaffian equations, it is shown that the stress tensor is derivable from a scalar potential function. R.S.Pease

531.259

3512. NOTE ABOUT FINITE STRAIN IN ELASTIC BODIES. E.J.Post.
Physica, Vol. 22, No. 3, 243-6 (March, 1956).

Deals with the problem of finite changes in the distance configuration of the constituent particles of an elastic body,

considering the path of displacement. A general invariant strain series is obtained, expressing the first and higher order contributions of strain as a function of a one parameter field of deformation. A.

531.55/.57

3513. NOTE ON THE EQUATION OF MOTION OF A ROCKET. B.Saelman.
Amer. J. Phys., Vol. 24, No. 1, 43 (Jan., 1956).

The validity of the equation of motion of a rocket in the form $F = F_1 + mc = Ma$, where $F_1 = -(D + Mg)$, D denoting the aerodynamic drag force and F the net unbalanced force on the rocket, is established for any frame of reference not accelerating with respect to the earth, or a frame instantaneously at rest with respect to the rocket. The gravity term equals Mg only when the height of the rocket is small compared to the radius R of the earth, and in general is expressed by $Mg(R^2/r^2)$, where r is the rocket's distance from the earth's centre. D is different in the subsonic, transonic, supersonic and hypersonic speed ranges. J.S.G.Thomas

MECHANICAL MEASUREMENTS 531.7

531.717.7

3514. A NOTE ON THE ACCURACY OF MEASUREMENT OF RADIUS OF CURVATURE OF PROOF GLASSES WITH A RING SPHEROMETER. V.Blumová and J.Hrdlička.
Optik, Vol. 13, No. 3, 122-7 (1956). In German.

Previous papers, e.g. Jensen (Abstr. 1568/1955) have discussed the best approximation to the ring radius to be used in calculation of results of spherometer measurements. An exact equation is derived and this is shown to give most accurate results if the mean square value is used to obtain the first approximation to the radius of the proof glass. R.W.Fish

531.75 : 536.25

3515. REPRODUCIBILITY OF THE WEIGHT OF A GLASS CONTAINER. T.Carlsen.
Fysisk T., Vol. 53, No. 2-6, 87-106 (1955). In Danish.

Series of experiments to establish the relation between the excess temperature of a copper or glass plate over that of the surrounding air and the apparent loss of weight.(Of the order of 0.5 mg per 1^0C for a plate 10 x 10 x 1 cm). Convection is found to be responsible and a semiquantitative interpretation is found to be possible. See T.Carlsen, Dansk Tidsskrift for Farmaci, Vol. 29, 21, 66 (1955).
W.J.Swiatecki

531.787.9

3516. SIMPLE SENSITIVE ELECTRICAL PRESSURE GAUGE. K.M.Sancier and W.Richeson.
Rev. sci. Instrum., Vol. 27, No. 3, 134-6 (March, 1956).

A simple, sensitive, electrical pressure measurement device has been constructed which is capable of measuring and recording absolute or differential pressures of corrosive materials of isolated systems. A linear variable differential transformer attached to a sylphon bellows indicates differential pressure across the bellows or serves as a null indicator when an unknown pressure on one side of the bellows is balanced with a gas of measurable pressure on the other side. In order to prevent inelastic deformation, the motion of the bellows is limited to 60 mm Hg, although larger pressure differentials can be measured. The sensitivity is independent of temperature and pressure and the device can be compensated for temperature. Absolute pressures and small differential pressures can be measured to $\pm$ 0.02 mm Hg with an input signal of 2 kc/s, and to $\pm$ 0.005 mm Hg with an input signal of 10 kc/s. A vacuum tube voltmeter with a full scale of 1 millivolt is used as the output indicator. A.

MECHANICS OF FLUIDS 532

532.123 : 532.73

3517. NON-NEWTONIAN VISCOELASTIC PROPERTIES OF ROD-LIKE MACROMOLECULES IN SOLUTION. J.G.Kirkwood and R.J.Plock.
J. chem. Phys., Vol. 24, No. 4, 665-9 (April, 1956).

The theory of Kirkwood and Auer is extended to include the dependence of the viscoelastic moduli of solutions of rod-like macromolecules on rate of shear. Power series expansions in the rate of shear of the intrinsic viscosity and intrinsic rigidity are constructed. In the stationary case, the intrinsic viscosity is presented as a function of rate of shear with use of coefficients of the pertinent spherical harmonics. A.

532.13 : 532.612.4

3518. RELATION BETWEEN VISCOSITY AND SURFACE TENSION OF LIQUIDS. N.K.Sanyal and S.S.Mitra.
J. chem. Phys., Vol. 24, No. 2, 473 (Feb., 1956).

It is shown that $T \log\eta - a\delta = b$ where T = abs. temperature, η = viscosity, δ = surface tension and a, b are constants, fits the properties of water and alcohol between 273^0K and the boiling points. For water a is 66.56 and b is ~29.6, for alcohol a is 10.68 and b is ~19.8. R.C.Murray

532.133 : 532.584

3519. THE WALL EFFECT AND THE VISCOMETRY OF SUSPENSIONS. A.D.Maude and R.L.Whitmore.
Brit. J. appl. Phys., Vol. 7, No. 3, 98-102 (March, 1956).

When the viscosity of a suspension of spherical particles uniformly distributed in a simple liquid is measured in a capillary tube viscometer, a wall effect, which is not found with coaxial rotating cylinder viscometers, is observed. The paper suggests that it may be caused by a redistribution of a portion of the suspension particles on entering the tube of the viscometer, leading to a reduction in both the concentration and viscosity of the suspension near to the walls of the tube. The diminution in concentration is measured experimentally and found to yield a value for the wall effect which is in agreement with that obtained from viscosity measurements. The reason for the redistribution of the particles at the tube inlet is discussed. A.

532.51 : 523.7 : 538.3 : 550.38

HYDROMAGNETIC PHENOMENA: A REVIEW. See Abstr. 3383

532.51 : 532.528

3520. REGULAR LAMINARY DETACHMENT (AND FLOW OF A VISCOUS COMPRESSIBLE FLUID, TRAVERSED BY QUASI-SHOCK WAVES, FROM A BOUNDARY). R.Legendre.
C.R. Acad. Sci. (Paris), Vol. 241, No. 12, 732-4 (Sept. 19, 1955). In French.

The flow of a viscous, compressible fluid, traversed by quasi-shock waves, in the neighbourhood of, and its detachment from, an isothermal boundary the specific mass of which depends only upon the pressure in its neighbourhood, is discussed mathematically. The mathematical relation to be satisfied for adherence of a viscous fluid to the boundary of an obstacle in the fluid, is $\overline{V} = ZF$, where $\overline{V}$ denotes the velocity of the fluid, Z the distance to the boundary or an appropriate regular function of the distance to the boundary, and F is a regular finite vector or vector function for Z = O. The gradient of current surface detached from a boundary is three times that of the pressure gradient; in three-dimensional flow this gradient is either very small or nearly thrice that of the plane containing the pressure gradient and tangential to the line of detachment. Detachment cannot be analysed when the pressure gradient is ignored. J.S.G.Thomas

532.51 : 778.34

3521. CHROMOPHOTOGRAPHY OF NON-STATIONARY FIELDS OF FLOW. G.Batailler.

C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 452-4 (Jan. 23, 1956). In French.

The evolution of fields of fluid flow is studied by the technique of chromo-photography applied to fine particles held in suspension in the fluid. The experimental technique uses low-tension circuits constituting a three-phase generator supplying three xenon-discharge lamps. Examples are given of results relating to the initiation of fluid motion by the motion of a plane plate, showing the generation of vortices. Theoretical deductions from the results suggest a value of the resistance about twice that found by Reynolds in the permanent regime for a value of the Reynolds number equal to about 14 000. J.S.G.Thomas

532.517.4 : 519.2

3522. STATISTICAL THEORY OF TURBULENCE. III. EXTENSION OF SIMILARITY THEORY OF TURBULENCE. Y.Shigemitsu.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1077-87 (Dec., 1955).

For Pt II, see Abstr. 110 (1956). As the second stage of development of the theory, an extension of the initial-period similarity-law is attempted in order to give general explanations to distributions of turbulent quantity across the mean direction of flow, particularly in decaying and non-decaying shear turbulence. As the statistical hypothesis in the theory, the Gaussian form is first given to the P-function. Then, as a simple theoretical result of the extended similarity law, it can be proved that the distribution of an intermittency factor γ, introduced by A.A.Townsend in his study of turbulent wake, takes the form of Gaussian-integral function, which is surveyed further by experimental observations. By introducing this result into the fundamental expressions of turbulent intensity, it is concluded that in all the cases of shear turbulence $u/\sqrt{(u^2+v^2)}$, $\overline{uv}/uv$ and w/u have nearly constant values in the y-direction. These characters are investigated by experimental measurements. As the first step towards studying the $\overline{V}_*$-function in shear turbulent state, the problem of distortion of isotropic turbulence in a contracting stream is taken up. From a rather qualitative hydrodynamical discussion on the $\overline{V}_*$-function in shearless turbulence with a non-uniform mean velocity, the fundamental formula in this case gives a result that $v/u = \overline{U}(x)/\overline{U}_0$, which is also checked in the measurements. The Reynolds stress distribution is then derived across a symmetrical shear turbulence, which is the simplest shear turbulence and corresponds nearly to a free mixing flow. Mean velocity distributions are also determined by the Reynolds equations. They are compared with the experimental measurements. A.

532.574.6

3523. ON THE ELECTROMAGNETIC MEASUREMENT OF THE VELOCITY OF FLOW OF LIQUIDS. B.Thürlemann.
Helv. phys. Acta, Vol. 28, No. 5-6, 483-5 (1955). In German.

See also Helv. phys. Acta., Vol. 13, No. 5, 343-5 (1940).

The induced electric potential across a tube of rectangular cross-section through which a liquid flows perpendicular to a homogeneous magnetic field is derived. A possible application to the measurement of the outflow of rivers using the two banks as electrodes and the earth's field is referred to. S.Weintroub

532.59 : 531.719.35

3524. AN ULTRASONIC APPARATUS FOR RECORDING THE HEIGHT OF WATER WAVES IN MODEL SHIP TANKS. E.G.Richardson.
J sci. Instrum., Vol. 33, No. 3, 91-2 (March, 1956).

An apparatus is described for measuring the height of water waves on the surface of a model ship towing or manœuvring tank. The apparatus uses an ultrasonic transducer on the bed. This pulses toward the surface and the echoes returned from successive crests and troughs are recorded continuously on an oscillograph. A

CAPILLARITY 532.6

532.61.08

3525. METHOD FOR THE DETERMINATION OF THE SURFACE TENSION OF SOLIDS, FROM THEIR MELTING POINTS IN THIN WEDGES. R.C.Sill and A.S.Skapski.
J. chem. Phys., Vol. 24, No. 4, 644-51 (April, 1951).

A method is proposed which allows one to measure the surface tension of solids whose liquids wet glass and steel and whose solid/liquid contact angle against those materials is zero. A thin wedge, formed of optically flat steel and glass slabs, is filled with liquid substance and then allowed to solidify. It is then immersed in a large heat bath whose temperature is raised at a rate of about 1.5 deg C per 24 hours, and is known at any time within ± 0.002 deg C. The solid substance starts melting from the thinnest part of the wedge, well below its "normal" melting point T_m. From the lowering of the melting point ΔT corresponding to a measured thickness h of the wedge in the solid-liquid interface, the surface tension of the solid σ_s is then arrived at from the equation:

$$\sigma_s = \frac{Q_f \rho_s}{2T_m} h\Delta T + \sigma_L,$$

where Q_f is the heat of fusion in erg/g, ρ_s the density of the solid, and σ_L the surface tension of the substance in liquid state. The method was applied to stearic and myristic acids. For myristic acid four independent measurements gave an average value of $\sigma_s = 116 \pm 10$ erg/cm^2, all four samples showing similar orientation of the crystal lamellae (gross crystal orientation) with respect to the interface solid/liquid. For stearic acid three similar gross orientations gave an average $\sigma_s = 179 \pm 8$ erg/cm^2. One gross orientation, markedly different from the others, yielded the value of $\sigma_s = 135 \pm 6$ erg/cm^2. Thickness h was determined from the interference lines (sodium light). The gross orientation was observed in polarized sodium light. A.

532.612.4

3526. LIQUID METALS. II. THE SURFACE TENSION OF LIQUID SODIUM: THE DROP-VOLUME TECHNIQUE. C.C.Addison, W.E.Addison, D.H.Kerridge and J.Lewis.
J. Chem. Soc., 1955, No. 7, 2262-73 (July).

The surface tension of liquid sodium in an atmosphere of pure argon was measured over the temperature range 110-220° by a drop-volume method, which is described. The temperature coefficient of tension is -0.1 dyne cm^{-1} deg^{-1}, and extrapolation of results to the melting point of sodium gives $\gamma = 202$ dynes cm^{-1}. Results are compared with those obtained by the vertical plate method in Pt I (Abstr. 10852 1954). A.

532.612.4

3527. LIQUID METALS. III. THE INFLUENCE OF OXIDE FILMS ON THE SURFACE TENSION OF LIQUID SODIUM. C.C.Addison, W.E.Addison and D.H.Kerridge.
J. Chem. Soc., 1955, 3047-55 (Sept.).

The drop-volume technique has been used to determine the changes in surface tension of liquid sodium which occur when dry air is introduced into the argon atmosphere surrounding the metal drops. At 180°, the surface tension decreases linearly with partial pressure of oxygen, from 194 to 186 dynes/cm. A minimum occurs at an oxygen partial pressure of 2×10^{-4} atm, after which the tension can increase to very high values. The tension minimum is related to the change from a soluble to an insoluble film of sodium oxide at the metal surface. A.

532.614.2 : 536.48

3528. QUANTUM EFFECTS IN THE THEORY OF SURFACE ENERGY. A.Harasima and Y.Shimura.
J. Phys. Soc. Japan, Vol. 11, No. 1, 14-21 (Jan., 1956).

Applying Prigogine's method of calculating the cohesive energy and the volume of liquid helium at 0°K and also

Prigogine's method of calculating the surface tension, the authors discuss quantum effects in the theory of surface energies of several substances at 0^0K. Assuming that the intermolecular potential is of the form

$$\phi(R) = 4\epsilon\left[(\sigma/R)^{12} - (\sigma/R)^6\right],$$

the reduced surface energy at 0^0K, $U_0^* = U_0\sigma^2/\epsilon$, can be expressed as a function of the quantum mechanical parameter. $\Lambda^* = h/(\sigma\sqrt{m\epsilon})$, where m is the mass of a molecule. It is shown that U_0^* decreases with increasing Λ^* in agreement with observed tendency. A.

532.62 : 541.182.2

3529. SHAPE DISTRIBUTION OF TWO-DIMENSIONAL SOAP FROTHS. R.Kikuchi.
J. chem. Phys., Vol. 24, No. 4, 861-7 (April, 1956).

In the two-dimensional soap froths, made in the narrow space between two parallel glass plates, thin soap films partition the space into polygonal cells. The probability of occurrence of n-sided polygons ($3 \leq n \leq 12$) is calculated from two models, using the technique previously developed by the author for cooperative phenomena. The theory explains the observations semiquantitatively. A.

532.68

3530. PHYSICAL THEORY FOR CAPILLARY FLOW PHENOMENA. E.E.Miller and R.D.Miller.
J. appl. Phys., Vol. 27, No. 4, 324-33 (April, 1956).

From the assumption that the microscopic behaviour of the liquid in an unsaturated porous medium is controlled by the physical laws of surface tension and viscous flow, differential equations governing the macroscopic flow in such a medium are deduced. No special pore-shape assumptions are required, but one topological approximation is needed; i.e., that neither isolated drops nor isolated bubbles occur. Several nonessential simplifying assumptions are used; i.e., that the macroscopic properties of the medium, the character of the liquid, and the pressure of the gas are independent of position, time and direction. The macroscopic equations are obtained in a fully reduced form, permitting comparison between two media — or between two flow systems — that differ only by scaling factors. A novel feature of this calculation is its prediction that the liquid-transmission and liquid-capacity properties of an unsaturated medium will exhibit hysteresis in their dependences upon the liquid-gas pressure differential, p. The properties of the medium depend upon the pressure history but are invariant to monotonic time-scale distortions of that history. Such time-invariant functionals have been termed by the authors "hysteresis functions", symbolized by the subscript, H, e.g. $F_H(p)$. Although methods for measuring and describing the characteristics of specific "hysteresis functions" have not yet been developed, the general validity of this analysis can be studied experimentally by testing predictions that are contained in the reduced variables. A.

532.696.1 : 539.4.01

ON THE CHARACTERISTIC OF THE WEAKENING EFFECT. See Abstr. 3322

532.696.1 : 539.4.01

THE WETTING EFFECT ON QUENCHED CARBON STEEL WITHIN ITS ELASTIC LIMIT. See Abstr. 3323

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

3531. CELL AND CELL-CLUSTER MODELS FOR LIQUIDS. H.S.Green.
J. chem. Phys., Vol. 24, No. 4, 732-7 (April, 1956).

The theory of the cell model is developed in its most general form, allowing an arbitrary volume and a variable number of occupants to each cell. Kirkwood's principle of minimizing the free energy is used to determine the best cell distribution functions and thermodynamic functions. It is shown that the isotherms computed by Lennard-Jones and Devonshire are subject to two large but almost compensating corrections. It is proposed to eliminate the inconsistencies of the cell model by introducing de Boer's concept of cell clusters, which in principle allows an exact evaluation of the partition function. Numerical corrections for clusters of two cells are calculated and shown to be small in effect. A.

532.7

3532. INTEGRAL EQUATION METHOD IN THE THEORY OF LIQUIDS. L.Sarolea and J.E.Mayer.
Phys. Rev., Vol. 101, No. 6, 1627-40 (March 15, 1956).

The integral equation method in the treatment of the equation of state, particularly for liquids, can be regarded as the problem of the solution of the reciprocal of a known matrix having the activity as a parameter, and dependent on the pair potential divided by kT. The Kirkwood and Yvon-Born-Green integral equations are shown to be special cases of the general operation by which the equations can be derived. The solutions are usually made by a closure which can be called the Kirkwood approximation. If this approximation is consistently used a considerable number of different equations can be derived, which, however, need not all lead to identical answers, due to the error in the approximation. The simplest method of correction of the approximation by successive steps leads to a divergent procedure. A very simple integral equation can be derived by an approximation somewhat analogous to that of Kirkwood. The solution of this equation does show phase transitions, but with little resemblance to those actually observed. A somewhat more complicated equation, of the same order of complexity as that of Kirkwood, is also derived in which the type of approximation used is not that of Kirkwood. A.

532.7 : 536.632

3533. THE RATIO OF SPECIFIC HEATS γ AS A FUNDAMENTAL PHYSICAL PROPERTY OF LIQUIDS. S.Parthasarathy.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 178-84 (1956).

The ratio of specific heats (γ) of liquids behaves with regularity in organic liquids; in homologous series; with substitution; with molecular weight etc. It also enters in processes like light-scattering and sound absorption. In fact, the observed sound absorption of liquids can be explained only on the basis of both γ and viscosity. From these considerations it is suggested that γ is a fundamental physical property of liquid state. On account of its main contribution to sound absorption in liquids, it is suggested that γ of a liquid might be termed its "sonic anisotropy". A.

532.72

3534. DIFFUSION (OR CONDUCTION) ALONG A SLIGHTLY TAPERING TUBE, AND ITS APPLICATION TO THE DETERMINATION OF DIFFUSION COEFFICIENTS. A.Talbot and J.A.Kitchener.
Brit. J. appl. Phys., Vol. 7, No. 396-7 (March, 1956).

The diffusion equation has been solved for the case of diffusion from a slightly tapering tube into an infinite medium of zero concentration. The theory provides a means of correcting results obtained for diffusion coefficients in the capillary tube method of Anderson and Saddington, when the tube is not of uniform bore throughout its length. This is frequently the case when silica capillary tubes have to be used (as for high-melting substances) and the correction is often significant. A.

532.72

3535. INTERACTING FLOWS IN LIQUID DIFFUSION: EQUATIONS FOR EVALUATION OF THE DIFFUSION COEFFICIENTS FROM MOMENTS OF THE REFRACTIVE INDEX GRADIENT CURVES. R.L.Baldwin, P.J. Dunlop and L.J.Gosting.
J. Amer. Chem. Soc., Vol. 77, No. 20, 5235-8 (Oct.20, 1955).

For systems of three or more components, flow equations of a more general form than Fick's first law may be required to describe the process of diffusion. Generalized flow equations for liquid systems are proposed which are purely phenomenological and which follow from certain considerations of Onsager. Using these flow equations, expressions for the moments of refractive index gradient curves observed in free diffusion are derived in closed form and for any number of components. The four diffusion coefficients which appear in the flow equations for a three-component system are then expressed in terms of the second and fourth moments for two experiments. Providing that both the specific refractive increments and the diffusion coefficients do not vary appreciably across the diffusion boundary (as assumed in the derivations), it is shown that the refractive index gradient curves are symmetrical about the position of the initially sharp boundary. A.

532.72

3536. INTERACTING FLOWS IN LIQUID DIFFUSION: EXPRESSIONS FOR THE SOLUTE CONCENTRATION CURVES IN FREE DIFFUSION, AND THEIR USE IN INTERPRETING GOUY DIFFUSIOMETER DATA FOR AQUEOUS THREE-COMPONENT SYSTEMS. P.J.Dunlop and L.J.Gosting.
J. Amer. Chem. Soc., Vol. 77, No. 20, 5238-49 (Oct. 20, 1955).

By using an extension of Fick's first law to represent interacting flows in three-component systems, series expansions are developed for the concentration of each solute as a function of time, position and four diffusion coefficients. These expressions converge rapidly when either of the two cross-term diffusion coefficients is small. From these series expansions, equations are derived relating the diffusion coefficients to the reduced height-area ratio, D_A, and to the fringe deviation graphs which provide a measure of deviations of the refractive index gradient curve from Gaussian shape. To test these relations, data are presented from several experiments with the Gouy diffusiometer in which lithium chloride and potassium chloride diffused simultaneously. An electrolyte system was chosen with the hope that it would exhibit greater interaction of flows than a non-electrolyte system through electrostatic coupling of the flows of ions of different mobility; assuming that the flow equations are valid, the series expansions are applicable to either case. In all experiments the mean concentration of a given solute was the same, but the ratio of their concentration increments across the boundary was varied from experiment to experiment. Values were chosen for the four diffusion coefficients which best fit the reduced moments (preceding abstract), reduced height-area ratios, and fringe deviation graphs of the several experiments. The results provide evidence for the validity of the flow equations. Data are also reported for the simultaneous diffusion of lithium and sodium chlorides in aqueous solution. The four diffusion coefficients for this system are calculated from reduced moments of the refractive index gradient curves: neither cross-term diffusion coefficient is small enough to permit use of the equations for the fringe deviation graphs. A.

532.72

3537. STUDIES OF FREE DIFFUSION IN LIQUIDS WITH THE RAYLEIGH METHOD. I. THE DETERMINATION OF DIFFERENTIAL DIFFUSION COEFFICIENTS IN CONCENTRATION-DEPENDENT SYSTEMS OF TWO COMPONENTS. J.M.Creeth.
J. Amer. Chem. Soc., Vol. 77, No. 24, 6428-47 (Dec.20, 1955).

Expressions are given relating the deviations between ideal and observed fringe positions in Rayleigh diffusion interferograms to the various coefficients describing the concentration-dependence of both the diffusion coefficient and the refraction increment; rigorous methods are given for the calculation of differential diffusion coefficients in such systems. The expressions have been tested by using them to predict the deviations to be expected in the cases of sucrose, glycine and butanol, where adequate concentration-dependence data are already available. Reasonable success has been achieved in this prediction. Some of the likely sources of error in Rayleigh diffusion work are examined and two examples are given of a comparison between Gouy and Rayleigh results obtained in the same experiment. A.

532.72

3538. DIFFUSION COEFFICIENT MEASUREMENTS WITH GLASS DIAPHRAGM CELLS. J.R.White.
J. chem. Phys., Vol. 24, No. 2, 470-1 (Feb., 1956).

Comparison of two measurements of integral diffusion coefficients for diphenyl in benzene suggests that porous glass diaphragms are reliable to about 6% when comparing diffusion in widely different solutions. R.S.Pease

532.72

3539. CRITERION FOR ALLOWABLE ANGULAR DEVIATION IN SCHLIEREN MEASUREMENTS OF THE SORET COEFFICIENT. J.A.Bierlein and C.R.Finch.
J. chem. Phys., Vol. 24, No. 2, 486-7 (Feb., 1956).

An expression giving the angular deviation γ of a light beam passing through a cell used for the measurement of binary Soret coefficients (Abstr. 2470/1955) is strictly true only for vanishingly small values of γ. In practice therefore γ is kept small, usually by restricting the temperature differenc τ across the cell. Expressions are derived for the permissable values of γ and τ such that the error due to the finite value of γ is small compared with the experimental error. H.C.Cole

532.72

3540. SELF-DIFFUSION IN LIQUID MERCURY. N.H.Nachtrieb and J.Petit.
J. chem. Phys., Vol. 24, No. 4, 746-50 (April, 1956).

Self-diffusion in liquid mercury was determined by a shear cell method. At atmospheric pressure, $D = 8.5 \times 10^{-5}$ exp(– 1005/RT) $cm^2\ sec^{-1}$ from 0° to 98°. At 30° for pressures ranging up to 8366 kg cm^2, $\log_{10}D = -0.572T_m/T - 4.348$, or $\log_{10}D = -4.7889 - 9.637 \times 10^{-4}P$ (kg cm^{-2}). The activation volume is 0.587 cm^3. The pressure dependences of viscosity and diffusivity are identical within experimental error, but the temperature variations are not equal. The results are discussed in terms of an imperfect crystal lattice model of a liquid. A.

532.72 : 537.534

3541. DIFFUSION OF SALTS AND STABILITY OF THE "ENCAGED" PROTON. G.Darmois.
C.R. Acad. Sci. (Paris), Vol. 242, No. 3, 365-8 (Jan. 16, 1956). In French.

It is established for diluted solutions of 1-1 electrolytes that the coefficient of diffusion of the electrolyte is equal to the harmonic mean of the coefficients of diffusion of the two ions. The following coefficient values are calculated for the cations: H, 10×10^{-5}; Li, 1.05×10^{-5}; Na, 1.33×10^{-5} and K, 2×10^{-5} (Cl, also 2×10^{-5}). From Einstein's diffusion theory one obtains that the time elapsing between two exits of the proton from its "cage" is = 3.92×10^{-12} sec. F.Lachman

532.74 : 539.132

3542. NUCLEAR MAGNETIC RELAXATION OF NONUNIFOR SYSTEMS. S.Broersma.
J. chem Phys., Vol. 24, No. 4, 659-65 (April, 1956).

The effect of electrolytic ions in water upon the proton magnetic relaxation is discussed. Formulae pertaining to solutions of paramagnetic and nonmagnetic ions are derived. The viscosity factor occurring in the theory for uniform systems has to be replaced by an average of inverse local viscosities weighted by the dimensions of the moving particles or by individual diffusion constants. The concept of mutual viscosity — describing the interaction between two unlike liquid layers — is helpful in correlating the numerical results. The influence of temperature and concentration has been studied experimentally. The behavio of trivalent ions like aluminium can be understood by assuming

hydration. The effect of monovalent ions can be explained on the basis of a slightly decreased diffusion constant of the free water molecules. Treated as a two-phase system, the experimental results enable the evaluation of the average time of adsorption. For aluminium, this is one-hundredth of a second. A.

MECHANICS OF GASES 533

533.15 : 539.155.2

3543. THE SEPARATION TUBE. XVI. PREPARATION IN PURITY OF THE ISOTOPE Xe^{136}. K.Clusius, H.H.Bühler, H.Hürzeler and E.Schumacher.
Z. Naturforsch., Vol. 10a, No. 11, 809-14 (1955). In German.

For Pt XV, see Abstr. 9475 (1955). 1.35 g Xe^{136} of 99% purity have been produced in a 48 m thermal diffusion plant by a 3-stage process. Even-even isotopes of Xe are of interest for a spectroscopic wavelength standard, because of all elements except He, Xe has the highest M/T value for a given vapour pressure. H.London

533.275

3544. ON THE MEASUREMENT OF THE HUMIDITY OF AIR. R.E.H.Rasmussen and N.Jonassen.
Fysisk T., Vol. 53, No. 2-6, 107-25 (1955). In Danish.

In addition to a review of measuring methods, experiments are reported on the testing of two hair hygrometers and of Assman psychrometers by means of absolute determinations. A simple formulation of the theory of the ventilated psychrometer is given. A small correction to Sprung's formula (for the Assman psychrometer) is derived. W.J.Swiatecki

533.275

3545. A FAST RESPONDING ELECTRIC HYGROMETER . A.Wexler, S.B.Garfinkel, F.E.Jones, A.Hasegawa and A. Krinsky.
J. Res. Nat. Bur. Stand., Vol. 55, No. 2, 71-8 (Aug., 1955).

The performance characteristics of a fast responding electric hygrometer of high sensitivity are presented in some detail. The hygrometer is made by evaporating, under vacuum, potassium metaphosphate to obtain a thin film of material (3 microinches thick) on a specially treated glass blank. The logarithm of the resistance is approximately linear with relative humidity at constant temperature. In comparison with lithium chloride elements currently produced for radiosonde use, the response time of the element was found to be less by at least an order of magnitude. A.

533.275

3546. A WATER VAPOUR RECORDER FOR EQUATORIAL USE. C.G.Webb and A.Rajaratnam.
J. sci. Instrum., Vol. 33, No. 4, 132-4 (April, 1956).

A considerable extension of the range and accuracy of the thermocouple hygrometer is possible in an equatorial climate, owing to the small range of variation of atmospheric pressure and temperature. An instrument, with a linear range of water vapour pressure of 10-30 mm of mercury, has been designed for use in latitudes 0 ± 5^{0}. Systematic departures from linearity were less than 0.2 mm on direct calibration. The use of a new reference temperature close to the mean air temperature is convenient, and with it a single check measurement suffices for standardization of the hygrometer. A.

533.41

3547. BALANCE-BAROMETER. J.M.Torroja Miret and E.Pajares Díaz.
Rev. Cienc. apl., Vol. 10, No. 1, 1-12 (Jan.-Feb., 1956). In Spanish.

An illustrated description of a mercury barometer of which the open and the vacuum parts of the tube are both vertical, joined by an oblique tube of small bore. The whole is mounted on an iron frame consisting of two vertical arms supporting the open and the vacuum parts of the tube, and a horizontal arm joining the vertical arms about half way up the inclined tube. The horizontal arm is pivoted by a knife edge on a horizontal plane and has a small counterpoise sliding on it for balancing the barometer when temperature or pressure changes cause displacement of the mercury. The theory is developed and applications are given. J.A.Wilcken

533.42

3548. CORRECTION OF MILLIMETRE MERCURY BAROMETERS. D.Ambrose and P.H.Bigg.
J. sci. Instrum., Vol. 33, No. 3, 126 (March, 1956).

British Standard 2520 : 1954 relates to barometers with scales calibrated at 0^{0}C. The corrections to be applied when the scale is calibrated at 20^{0}C are outlined. It is pointed out that in the South of England the net result of applying both the gravity and calibration temperature corrections is very small. S.Weintroub

533.59

3549. FAST-CLOSING VACUUM VALVE. A.W.Knudsen.
Rev. sci. Instrum., Vol. 27, No. 3, 148-50 (March, 1956).

A swinging-gate type valve with associated triggering mechanism is employed as a protective device for quickly stopping a sudden accidental inrush of air to a vacuum system. The electrical triggering mechanism uses no electron tubes. For a large inrush of air, the valve will close in less than 0.01 sec. A.

533.6 : 532.525.51 : 535.822.17

3550. APPLICATION OF PHASE CONTRAST TO THE STUDY OF GAS FLOWS. R.Bouyer.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 451-2 (Jan. 23, 1956). In French.

The technique of phase contrast is particularly suitable for the study of gas flow, of small cross-section, in which the density is about atmospheric, so that the "out-of-phase" relation is small compared with the wavelength. The apparatus used comprises a symmetrical system of two objectives separated by air; aerodynamic effects occurring in this interval are equivalent to a change in the optical system. An illuminated ring set up in the focal plane of one of the objectives produces an image in the focal plane of the other and coinciding with an annular phase plate, whereby continuous out-of-phase variations and absorption are made visible. The apparatus has been employed in the study of air-jets and jets composed of mixtures of gases of various densities; examples of results showing striation in jets are given. J.S.G.Thomas

533.6.011

3551. TOTAL PRESSURE IN FREE MOLECULAR FLOW. F.M.Devienne.
C.R. Acad. Sci. (Paris), Vol. 242, No. 1, 67-8 (Jan. 4, 1956). In French.

The total gas pressure and the static pressure were measured at various points along a pipe, and their ratio compared with the theoretical value, obtained on the assumption of Maxwellian velocity distribution. For mean flow velocities around 50 m/sec and static pressures around 0.5μ Hg the experimental ratios always exceeded the theoretical ones by 5 to 20%, showing non-Maxwellian distribution with preponderance of fast molecules. F.Ansbacher

533.6.011

3552. ON THE COMPATIBILITY EQUATIONS FOR GAS FLOW. R.Berker.
C.R. Acad. Sci. (Paris), Vol. 242, No. 3, 342-4 (Jan. 16); Erratum, No. 13, 1775 (March 26, 1956). In French.

The compatibility equations are given in general form for a compressible fluid subjected to an arbitrary external force; viscosity and thermal conduction are neglected, but no special form of the equation of state is assumed. It is shown how the density, pressure and equation of state can be obtained once the velocity field has been determined. E.H.Sondheimer

533.6.011

3553. EXPERIMENTAL INVESTIGATION OF THE WAKES BEHIND CYLINDERS AND PLATES AT LOW REYNOLDS NUMBERS. S.Taneda.
J. Phys. Soc. Japan, Vol. 11, No. 3, 302-7 (March, 1956).

The wakes behind cylinders and plates were photographically investigated at Reynolds numbers from 0.1 to 2000. The main results are as follows. In the case of a circular cylinder, the rear twin-vortices begin to form at R = 5 (R is Ud/ν), then become more and more enlarged as R increases, and finally become asymmetrical at about R = 45. The laminar wake, on the other hand, begins to oscillate sinusoidally some distance downstream at R = 30. In the case of a flat plate parallel to the flow, the wake begins to oscillate sinusoidally some distance downstream at about R = 700 (R is Ul/ν, where l is the length of the plate). Lastly, some detailed information about the structure and the nature of the Kármán vortex street are obtained by a new method. A.

MOLECULAR THEORY OF GASES 533.7

533.7

3554. VIRIAL COEFFICIENTS OF "PARALLEL SQUARE" AND "PARALLEL CUBE" GASES. R.W.Zwanzig.
J. chem. Phys., Vol. 24, No. 4, 855-6 (April, 1956).

The second, third, fourth and fifth virial coefficients are evaluated exactly for gases whose molecules interact in two dimensions as rigid elastic squares with their sides parallel or in three dimensions as rigid elastic cubes with their edges parallel. Upper and lower bounds on the virial coefficients of gases composed of rigid circles or rigid spheres are obtained in terms of the virial coefficients for the parallel squares and parallel cubes. A.

533.7

3555. USE OF THE BOLTZMANN EQUATION FOR THE STUDY OF IONIZED GASES OF LOW DENSITY. I. K.M Watson.
Phys. Rev., Vol. 102, No. 1, 12-19 (April 1, 1956).

The Boltzmann equation is studied for the case of a low-density ionized gas in an externally applied electromagnetic field. Particle–particle collisions are neglected, but long-range collective interactions are included. In Pt I the static problem is treated in detail. For this case the Boltzmann equation is solved using individual-particle orbits — an approach which emphasizes the physical basis of the solution. A.

533.7

3556. USE OF THE BOLTZMANN EQUATION FOR THE STUDY OF IONIZED GASES OF LOW DENSITY. II. K.A.Brueckner and K.M.Watson.
Phys. Rev., Vol. 102, No. 1, 19-27 (April 1, 1956).

The Boltzmann equation for ionized gases of low density in an external magnetic field is used to obtain approximate solutions in the nonstatic case. The Boltzmann and Maxwell equations are linearized by assuming small deviations from a static solution. It is shown that in the limit of a strong magnetic field ($\eta \ll 1$, as defined in the text), the motion transverse to the magnetic field is described by the conventional hydrodynamic equations. The variation along field lines is described by a one-dimensional (i.e., one space dimension and one velocity dimension) Boltzmann equation. Several applications are given, including an analysis of the Kruskal-Schwarzschild gravitational instability of a plasma. A.

VIBRATIONS. ACOUSTICS 534

534.12

3557. GROUP THEORY OF VIBRATIONS OF SYMMETRIC MOLECULES, MEMBRANES, AND PLATES. M.A.Melvin and S.Edwards, Jr.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 201-16 (March, 1956)

It is shown that the detailed group-theoretical analysis of molecular vibrations can be extended to continuous bodies of various shapes by regarding them as the limits of discrete systems with the number of particles becoming indefinitely large. In this paper an elementary review of the method is given and its application is illustrated with 2-dimensional systems and thin systems having pyramidal symmetry (i.e., tents and shells), Both stationary and rotating systems containing any number of particles arranged with the symmetry of a regular polygon or polygonal pyramid are considered. For macroscopic systems, unlike molecules, different possible constraints must be taken into account in enumerating the genuine vibrations of various types. Otherwise, one proceeds as in the molecular case. By going to the limit of large numbers of particles, one obtains the fractional occurrence-numbers of vibrations of various symmetry types for stationar or spinning membranes, plates, tents, or shells of all regular polygonal shapes.

534.141

3558. PERFORMANCE OF A TYPE B FOG HORN. G.J.Thiessen.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 281-5 (March, 1956).

Measurements on a type B fog horn indicate that the nominal frequency of 180 c/s is far from any resonance peak in the resistance ratio of the horn. Efficiencies of much less than one % are therefore commonly encountered. Actual diaphone frequencies in the field range between 180 and 245 c/s. The frequency stability with pressure is poor, and large deviations from symmetrical piston movement occur. It can generally be stated that a fog horn that "grunts" is not operating efficiently. A.

534.142.4/.5

3559. SURVEY OF ORGAN-PIPE OSCILLATIONS IN COMBUSTION SYSTEMS. A.A.Putnam and W.R.Dennis.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 246-59 (March, 1956)

Fifty-three references from the open literature dealing with organ-pipe combustion oscillations are reviewed; these oscillations were generated in various types of combustion systems by the flame, or the combustion process. The many systems discussed range from simple singing-flame burners to industrial furnaces and high-duty rockets. The combustion systems are classified, for purposes of discussion, according to the basic arrangement of the components of the unit. These classes are burners with singing diffusion flames, flash tubes, gauze-tone burners, rocket-shaped burners, burners utilizing secondary air, and ram-jet type burners. The acoustical behaviour of each system is described, and possible driving mechanisms for producing the observed oscillations are indicated. Some general remarks are made, based on the survey, concerning the mathematical formulation of mechanisms to explain the oscillations in particular cases. A

534.142.4/.5

3560. ORGAN-PIPE OSCILLATIONS IN A BURNER WITH DEEP PORTS. A.A.Putnam and W.R.Dennis.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 260-9 (March, 1956).

Data are presented on acoustic oscillations produced by a burner using a hexagonal bank of hypodermic tubes as deep

ports. Most of the tests were made with ethane as the fuel, but some tests were run with methane and propane, for comparison. Both the diameter and length of the combustion chamber were varied. It was found that the combustion chamber could be considered as a driver which forced the slugs of gas in the ports to oscillate. Burning of the incremental pulses of combustible mixture periodically issuing from the ports furnished energy to drive the oscillations when the pulses burned in phase with the oscillating component of the pressure in the chamber. The phasing depended on a time-lag factor which was a function of the velocity of the gases through a space, similar to dark space, between the burner ports and the mean burning points, and the width of the space itself. The oscillations not only ceased when there was a failure to satisfy the timing criterion, but also ceased upon approach to either rich or lean blowoff limits of the conventional type. This premature cessation apparently results from the flame burning from fewer ports as the limits are approached, less driving energy being available. A.

534.152 : 535.417

MULTIPLE-BEAM INTERFEROMETRIC METHOD OF STUDYING SMALL VIBRATIONS. See Abstr. 2813

534.213

3561. THEORY OF SOUND PROPAGATION BETWEEN PARALLEL BAFFLES. O.K.Mawardi.
J. Acoust. Soc. Amer., Vol. 8, No. 1, 127-8 (Jan., 1956).

A theory is given for the propagation of sound waves between absorbent parallel baffles, it being assumed that there are infinitely many parallel baffles. Of all the modes propagated down the channels, the lowest is considered to be the most important and is the only one studied in this paper. Matrix notation is used to compute the impedances and the results show that the problem of wave propagation between parallel baffles is reducible to the standard problem of the lined duct. This result has been assumed by earlier workers in this field without theoretical justification. A.C.Whiffin

534.213

3562. THEORY OF PROPAGATION OF ELASTIC WAVES IN A FLUID-SATURATED POROUS SOLID. I. LOW-FREQUENCY RANGE. M.A.Biot.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 168-78 (March, 1956).

A theory is developed for the propagation of stress waves in a porous elastic solid containing a compressible viscous fluid. The emphasis of the present treatment is on materials where fluid and solid are of comparable densities, as for instance in the case of water-saturated rock. Pt I is restricted to the lower frequency range where the assumption of Poiseuille flow is valid. The extension to the higher frequencies is treated in Pt II. It is found that the material may be described by four nondimensional parameters and a characteristic frequency. There are two dilatational waves and one rotational wave. The physical interpretation of the result is clarified by treating first the case where the fluid is frictionless. The case of a material containing a viscous fluid is then developed and discussed numerically. Phase velocity dispersion curves and attenuation coefficients for the three types of waves are plotted as a function of the frequency for various combinations of the characteristic parameters. A.

534.213

3563. THEORY OF PROPAGATION OF ELASTIC WAVES IN A FLUID-SATURATED POROUS SOLID. II. HIGHER FREQUENCY RANGE. M.A.Biot.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 179-91 (March, 1956).

The breakdown of Poiseuille flow beyond the critical frequency is discussed for pores of flat and circular shapes. As in Pt I the emphasis of the treatment is on cases where fluid and solids are of comparable densities. Dispersion curves for phase and group velocities along with attenuation factors are plotted v. frequency for the rotational and the two dilational waves and for six numerical combinations of the characteristic parameters of the porous systems. Asymptotic behaviour at high frequency is also discussed. A.

534.213 : 534.22

3564. THE PROPAGATION OF ULTRASONICS IN GASES UNDER PRESSURE. H.D.Parbrook and E.G.Richardson.
Portugal. Phys., Vol. 3, No. 3-4, 127-38 (1954). In French.

Measurements of ultrasonic velocity in carbonic acid and ethylene have been made using an interference method. The viscosities have also been measured using the oscillating cylinder method and the values compared with ultrasonic viscosities calculated using the Stokes equation. The velocities at various temperatures show sharp minimal turning points in the region of 60-90 atm. (approx.) while the two viscosities become minimal in roughly the same pressure range. From these and other observations the authors conclude that a thermal relaxation process might account for the anomalous behaviour. The paper is noteworthy for the extreme care which has been taken in the experimental work, for instance the lining up of the quartz crystal and the reflector is done using the Michelson interferometer method, and it is evident that the results are of a high order of accuracy. T.C.Toye

534.213 : 536.25

3565. ON THERMOACOUSTIC TRANSDUCTION IN A POTENTIAL FLOW. O.K.Mawardi.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 239-45 (March, 1956).

The interaction between an acoustic field and a thermal field is worked out for the case of a sound wave propagating down a channel in which the convection of heat occurs in a potential flow. The analysis restricted to inviscid fluids shows that the magnitude of the sound wave is reinforced as it propagates through the thermal field. The extent of this reinforcement is given in the form of an amplification factor which depends on the parameter of the flow and on the frequency of the sound wave. A.

534.213.4

3566. SOUND PROPAGATION IN A FLUID-FILLED TUBE WITH MASSIVE WALL REACTANCE. M.C.Junger.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 165-7 (March, 1956).

The results of an experimental study of a relatively unfamiliar mode of propagation are presented: the zero-order mode in a tube with massive wall reactance. The observed and theoretical dispersion curves, which show good agreement, display a high-pass cut-off frequency. There is a dead zone between this frequency and the ring resonant frequency of the tube. The phase velocities c_z are measured indirectly from the directivity patterns of a receiver in the form of a long rubber hose coupled to a microphone; these patterns are characterized by two symmetrical lobes whose angular separation is $2\cos^{-1}c/c_z$, c being the sound velocity. A.

534.222.2

3567. EXPLORATION, BY MEANS OF A WHIP, OF THE TWO FACES OF A SOUND WALL. Z.Carrière.
Cahiers de Phys., No. 63, 1-17 (Nov., 1955). In French.

The production and characteristics of the sound barrier produced by the cracking of a whip, defined as the geometrical surface separating infra- and super-sonic regions of sound propagation, are illustrated and discussed. The illustrations show the origin and successive instantaneous forms of the shock wave, and illustrate the marked curvature and feeble development of the supersonic trajectory, together with the apparent contour of the terminal node generator, in the rear of which no trace of a wave occurs. It is considered that the double-report heard when an aeroplane breaks through the sound barrier is satisfactorily explained, in respect to the very short interval of time separating the two reports and, more especially, their very slight difference of intensity, by considering reflection by the ground; multiple echoes are possible. Other matters discussed include the dynamics of the launching of the crack of a whip by a launching pulley, the

effect of the mass of the whip-cord, and methods of measuring and recording the extremely high velocities occurring, of the order 1000 metres/sec. J.S.G.Thomas

534.222.2

3568. THE INITIAL BEHAVIOUR OF A SPHERICAL EXPLOSION. I. THEORETICAL ANALYSIS. M.Holt.
Proc. Roy. Soc. A, Vol. 234, 89-109 (Jan. 24, 1956).

The analysis of the disturbance near the source of spherical blast from a polytropic explosive in which $\gamma = 3$, given in Berry and Holt (Abstr. 7203/1954), is generalized to apply to an explosive gas and a surrounding medium governed by any equations of state. Most of the properties established in the special case are found to be generally true. In particular, a second blast wave is shown to be a consequence of the breakdown of continuous gas flow in the neighbourhood of a singular characteristic. The complete field near the origin of blast can be determined from series expansions similar in type to those in Berry and Holt. Except in the gas expansion zone the coefficients in these expansions can be expressed in simple terms. The quantity defining the first departure of the second shock from the singular characteristic is given by an expression as simple as that in the polytropic case, although its derivation presents new difficulties. The analysis shows that, for all types of explosive, the second shock is a second-order effect in terms of the square root of the time from the end of detonation. This contradicts the conclusion reached earlier by Wecken (1951) on the basis of less detailed analysis. Application to actual explosions is described in the abstract following. A.

534.222.2

3569. THE INITIAL BEHAVIOUR OF A SPHERICAL EXPLOSION. II. APPLICATION TO P.E.T.N. CHARGES IN AIR AND WATER. M.Holt.
Proc. Roy. Soc. A, Vol. 234, 110-15 (Jan. 24, 1956).

The initial fields of disturbance due to explosions of spherical charges of P.E.T.N. in air and water are calculated, using the analysis developed in part I. The results in air compare favourably with earlier calculations (Berry and Holt 1954). In water it is found that the second blast wave immediately moves towards the centre of the explosion, with very small initial strength. A.

534.222.2 : 533.16

3570. SHOCK FRONT THICKNESS AND BULK VISCOSITY IN POLYATOMIC GASES. W.H.Andersen and D.F.Hornig.
J. chem. Phys., Vol. 24, No. 4, 767-70 (April, 1956).

The thickness of shock fronts in carbon dioxide and nitrous oxide gases has been measured by the light reflectivity method. The thickness of these fronts are in agreement with thicknesses predicted theoretically when only shear viscosity and heat conduction effects are considered. They demonstrate that the contribution of any real bulk viscosity is small. The molecular vibrations are not excited in the shock front and hence the large sound absorption in these gases in excess of that calculated using shear viscosity can only come from the vibrational excitation process. Real bulk viscosity in ideal gases is not a manifestation of vibrational excitation but only of the rotational excitation process. A.

534.23

3571. ABSORPTION OF ULTRASOUND IN LIGHT GASES. W.Tempest and H.D.Parbrook.
Nature (London), Vol. 177, 181 (Jan. 28, 1956).

A pulse method is described for measurements at 1 Mc/s. Absorption coefficients of 1.240 and 1.235 times the classical value are quoted for oxygen and nitrogen, respectively. The technique is being developed for measurements up to 20 Mc/s. G.F.Hodsman

534.23 : 532.73

3572. ULTRASONIC ABSORPTION IN SOLUTIONS. B.B.Deo.
Indian J. Phys., Vol. 29, No. 7, 352-6 (July, 1955).

Equations have been derived for the excess ultrasonic in solutions due to occurrence of chemical reaction accompanied by a change of volume. Modifications for aqueous solutions of electrolytes have been worked out. The results explain some of the anomalous values of sound absorption in bivalent sulphate solutions. A.

534.23 : 535.43

3573. BRILLOUIN COMPONENTS IN LIGHT SCATTERING IN RELATION TO SOUND ABSORPTION. S.Parthasarathy, D.S.Guruswamy and A.P.Deshmukh.
Ann. Phys. (Leipzig), Vol. 17, No. 2-3, 170-7 (1956).

A further study of light scattering in relation to sound absorption has revealed that the ratio of the intensity of the central component to the sum of the intensities of the Brillouin components is a function of total sound absorption, rather than of viscosity as interpreted from observations in liquids, or of γ, the ratio of the specific heats, only, as given by Landau–Placzek theory. That it depends on both viscosity and γ has been made clear from an interpretation of the results so far obtained in light scattering. This method enables one to determine the velocity and absorption of ultrasonic waves from light scattering experiments. A.

534.231 : 77

3574. A SIMPLE METHOD FOR THE VISUALIZATION OF ULTRASONIC FIELDS. Y.Torikai and K.Negishi.
J. Phys. Soc. Japan, Vol. 10, No. 12, 1110 (1955).

The method requires no special material except ordinary photographic paper and developer. A transducer is set in a tank filled with dilute developer and a sheet of uniformly exposed photographic paper is irradiated ultrasonically. Patterns appear on the paper as a result of the accelerated development depending on the intensity distribution of the field. Sample results are shown. G.F.Hodsman

534.232

3575. THE LIMITATIONS OF ELECTRO-ACOUSTIC TRANSDUCERS. F.Spandöck.
Elektrotech. Z. (ETZ) A, Vol. 76, No. 17, 598-604 (Sept. 1, 1955). In German.

Reversible transducers only are considered. Expressions are given for the electro-mechanical transformation factor. Typical values are given for the overall transformation factor, the sensitivity, and the efficiency. It is pointed out that for transmission and reception the efficiency seldom exceeds 5 and 2% respectively and each parameter is studied in turn to see how these figures could be improved. It transpires that improvements in one factor invariably lead to degradation of another and any appreciable improvement in efficiency can only be expected from superior basic materials, e.g. lighter and stronger membranes or magnetic materials with higher electrostrictive factors. H.G.M.Spratt

534.232

3576. EXPERIMENTAL CHARACTERISTICS OF CONTINUOUSLY VARIABLE RESONANT FREQUENCY CRYSTAL SYSTEMS. F.Dunn, F.J.Fry and W.J.Fry.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 275-80 (March, 1956).

The experimentally determined characteristics of a continuously variable resonant frequency crystal transducer are presented for the system operating under radiating conditions. These characteristics are presented for a high-power variable resonant frequency transducer of large radiating area, which utilizes the second harmonic and operates over the 2 : 1 frequency range from 22 to 44 kc/s with no more than a 2 : 1 variation in the pressure amplitude at a fixed point on the axis of the beam. Curves of pressure amplitude, input conductance, band width, half-power beam width, and efficiency, all as a function of the resonant frequency, are shown. The measured characteristics are compared with calculations based on a one-dimensional theory. A.

534.232

3577. HIGH POWER OPERATION OF A MAGNETOSTRICTIVE TRANSDUCER. R.M.Hoover.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 291-6 (March, 1956).

As a result of the nonlinear properties of magnetostrictive transducers their impedance and efficiency is a function of the amplitude of the driving field. Earlier studies of high-power operation of magnetostrictive transducers at the Harvard Underwater Sound Laboratory showed the need for further study of this subject. This earlier study has been extended by the use of a high-power amplifier recently installed at the ORL Black Moshannon Calibration Station. Impedance and efficiency data obtained on a nickel ring stack transducer operated with and without polarization are presented for a driving field range of 0.1 to 100 oersteds. The efficiency of the unpolarized transducer is shown to be comparable to that of the polarized transducer at high driving powers. Input current wave form was also observed in this study, and data are presented to show the dependence of wave form on current level. With the unpolarized transducer it is shown that the wave form is a function of nonlinear coupling as well as nonlinear magnetic properties. Both the experimental procedure used in this study, and the importance of the results to transducer operation at high power levels are discussed. A.

534.242

3578. ON THE THEORY OF THE ACOUSTIC RESONATOR. V.Thorsen.
Fysisk T., Vol. 53, No. 2-6, 162-78 (1955). In Danish.

It is shown that the existing theory of the Helmholtz resonator is not quite applicable to a double resonator. Two new formulae are derived, one for the eigenfrequencies of a single resonator and one for the relation between the acoustic characteristics of the inner and outer openings of a double resonator. The formulae are checked experimentally.

W.J.Swiatecki

534.26

3579. DIFFRACTION EFFECTS IN THE ULTRASONIC FIELD OF A PISTON SOURCE AND THEIR IMPORTANCE IN THE ACCURATE MEASUREMENT OF ATTENUATION. H.Seki, A.Granato and R.Truell.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 230-8 (March, 1956).

A study is made of the ultrasonic field produced by a circular quartz crystal transducer and the integrated response of a quartz crystal receiver with the same dimensions as the transducer. The transducer and receiver are taken to be coaxial, and it is assumed that the transducer behaves as a piston source while the integrated response is proportional to the average pressure over the receiver area. Computations are made for cases of interest in the megacycle frequency range ($ka = 50$ to 1000; a = piston radius; λ = wavelength; $k = 2\pi/\lambda$). The results contain features of use in identifying and correcting for diffraction errors. These features which apparently have been missed in previous investigations are compared with available experimental data. Finally correction formulae to account for diffraction effects in the accurate measurement of attenuation are discussed. It is shown that the order of magnitude of the diffraction attenuation is given by one decibel per a^2/λ. A.

534.26

3580. DIFFRACTION OF ELASTIC WAVES BY A SPHERICAL SURFACE. M.Nagase.
J. Phys. Soc. Japan, Vol. 11, No. 3, 279-301 (March, 1956).

To clarify the effect of the curvature of a surface on the propagation of elastic waves generated at a point source, as alluded to by Lamb in the case of a plane surface, the properties of waves in an infinite elastic medium enclosing a spherical cavity are investigated. Waves of any kind are shown to be represented as linear combinations of Φ, $A\varphi$, $d\varphi$, the scalar potential, the φ-component of the vector potential and the φ-component of the displacement, if the phenomena are independent of φ, the longitudinal angle in spherical polar coordinates with the polar axis joining the source and the centre of the cavity. Taking as the initial waves Φ, $A\varphi$, $d\varphi$ with monochromatic dipole character, solutions satisfying the boundary conditions are obtained in series forms, which are transformed into more rapidly convergent ones. In the first two cases the waves representing Φ, $A\varphi$ are found in three separated groups, corresponding to three types in the case of a plane surface; in the third only a group of solutions representing $d\varphi$ is found. The angular and distance dependence of their amplitudes and phases are investigated in detail. A.

534.26 : 539.312

3581. DIFFRACTION OF ELASTIC WAVES. L.Knopoff.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 217-29 (March, 1956).

An integral solution to the differential equations of elastodynamics is given. The solution for the displacement at any point in an isotropic homogeneous, elastic medium is obtained in terms of the initial distribution of body forces within a given volume and the initial distribution of displacements and stresses over the bounding surface of the volume. These quantities appear in the solution as retarded displacements, stresses, and body forces, with two types of retardation depending upon the velocities of longitudinal and transverse waves. From the integral solution the diffraction of elastic waves through large apertures bounded by opaque walls in solid materials is formulated. The incident wave motions may be either of longitudinal or transverse polarizations. The expected shear-compression interaction is obtained in the course of the computation. By analogy with optical procedure, Fraunhofer diffraction of elastic waves may be investigated as a special case. In the example of diffraction by a slit, an incident compression wave is diffracted into (1) a compression wave with the "ordinary" spatial distribution similar to that obtained in the corresponding optical problem and (2) a weaker shear wave with an "extraordinary" distribution. In the case of shear waves, there is obtained a diffracted shear wave with an ordinary distribution, and a possible weak compression wave with the extraordinary distribution. The presence of the diffracted compression wave depends upon the polarization of the incident shear wave. Opacity in the Kirchhoff sense is a property of materials which are perfectly rigid. A.

534.321.9 : 545.7

3582. SEPARATING EFFECT OF ULTRASONICS ON A GASEOUS MIXTURE. C.Eyraud.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 474-5 (Jan. 23, 1956). In French.

A piezoelectric quartz crystal vibrating at 720 kc/s is used to direct a pencil of ultrasound along a metallic tube 2 cm in diameter. A mixture of 50 volumes of nitrogen and 50 volumes of hydrogen is injected into the tube at atmospheric pressure and at a rate of 20 litres/hr at a distance of 3.5 cm from the quartz. At the level of the crystal, gas is drawn off at 10 litres/hr and a similar quantity is drawn off at a distance from it of 12 cm. Analysis of the gases showed that the composition had changed by about 0.5%. Nitrogen was displaced towards the quartz and hydrogen in the direction of propagation of the waves. It is suggested that the phenomenon, although small on the present occasion, might be quite important under other conditions of frequency and pressure. A.C.Whiffin

534.39

3583. THE RADIATION FORCE ON A SPHERICAL OBSTACLE IN A CYLINDRICAL SOUND FIELD. T.F.W.Embleton.
Canad. J. Phys., Vol. 34, No. 3, 276-87 (March, 1956).

The corresponding problems of the radiation forces acting on a spherical obstacle in a plane or spherical progressive sound field have been examined previously by King (Proc. Roy. Soc. A, Vol. 147, 212-40, Nov. 15, 1934) and Embleton (Abstr. 3231-2/1954) respectively. In these cases the sound field and scattering obstacle both have symmetry of revolution about the line joining the centre of the obstacle to the origin of the sound field, but for a cylindrical sound field there exists only a

much lower degree of symmetry. A general expression has been obtained for the radiation force in terms of the complex amplitudes of spherical harmonics required to synthesize the incident sound field — for the cases of greatest symmetry this reduces to the simpler expression previously obtained. The first 20 non-zero amplitudes have been evaluated for a cylindrical sound field and it is shown that the force is one of attraction near to the source, becomes zero at a certain distance, and is a force of repulsion at a greater distance. Qualitatively, this force is the same as for spherical waves but for any size of obstacle and frequency of the sound field the point of zero force is always nearer to the source in a cylindrical wave. A.

534.4 : 612.85

3584. ON THE ANALYSIS OF THE SOUND SPECTRUM INTO FREQUENCY GROUPS BY HEARING. R.Feldtkeller. Elektron. Rdsch., Vol. 9, No. 11, 387-9 (Nov., 1955). In German.

After referring to the observations of Fletcher and Munson on the response of the ear in the aural spectrum range, and to the structure and function of the organ of Corti, the author points out that there are known frequency groups in the aural range, which can be observed (1) by the measurement of the threshold of hearing (2) by masking, (3) by comparison of frequency-modulated and amplitude-modulated sounds and (4) by the growth of loudness. Experimental results in the form of graphs are given for these various methods. One of these graphs shows the breadth of the frequency-groups throughout the whole range of audible frequencies (50 c/s to 16 kc/s). It represents the mean of the results of all 4 methods of hearing analysis. The curve indicates for low frequencies a breadth of about 90 c/s, and at frequencies above 500 c/s a breadth of about 17% of the mean frequency. It is considered that these frequency groups are not formed by the organ of Corti, but by the auditory nerves arranged so that about 150 neighbouring cells of Corti's organ are coupled together. Out of this organ the sensory cells are arranged in four adjoining series — each series containing about 3500 sensory cells.

A.B.Wood

534.612

3585. ANOMALOUS BEHAVIOR OF RAYLEIGH DISK FOR HIGH-FREQUENCY WAVES. J.Awatani.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 297-301 (March, 1956).

The behaviour of the Rayleigh disk whose size cannot be neglected in comparison with the wavelength is investigated. Results obtained are as follows. The sensitivity of the disk set to an angle 45° increases with the frequency of sound and reaches a maximum at the frequency corresponding to $k\ (= 2\pi a/\lambda) \cong 1.6$, (a is the radius of the disk, λ the wavelength of sound). This maximum value is about 50% larger than that calculated from the König's expression. When k becomes larger than 1.6, however, the sensitivity begins to fall off and its sign, at last, changes to negative when $k \cong 4.5$. In the high-frequency region, the negative torque acts on the disk if the angle between its axis and the wave normal is small, but the positive torque if the angle is large. The disk displays the greatest sensitivity at an angle different from the ordinary angle 45°. A.

534.62

3586. ON THE MEASUREMENT OF ABSORPTION COEFFICIENTS OF ACOUSTIC MATERIALS BY THE METHOD OF THE REVERBERANT CHAMBER. R.Lamoral.
Ann. Télécomm., Vol. 10, No. 10, 206-16 (Oct., 1955). In French.

The author refers to disagreements in the measurement of absorption coefficients of materials by Sabine's reverberation method, in France and in the United States. After recalling the theoretical work of Sabine, a comparison is made between his formula for reverberation time and the modified formulae obtained by C.F.Eyring (J. Acoust. Soc. Amer., Vol. 1, No. 2, 217-41, Jan., 1930) and by G.Millington (J. Acoust. Soc. Amer., Vol. 4, No. 1, 69-82, July, 1932). Experiments now described by the author indicate: (1) With a certain area (metres^2) of acoustic material in the reverberation chamber the absorption coefficient due to Sabine is always too large when the area of absorbent is small; (2) when the area of absorbent in a room is constant, Sabine's coefficient is always increased if the total area of absorbent is divided into a large number of small areas; (3) the time of reverberation of a room varies with the position of microphone used in the measurement — an acoustic material is more effective in its vicinity than in a more distant location; (4) the sound level at the 'cut off' appears to have no influence on the results of the measurements. A.B.Wood

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85.

534.78

3587. SPECTRAL PROPERTIES OF FRICATIVE CONSONANTS. G.W.Hughes and M.Halle.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 303-10 (March, 1956).

Energy density spectra of gated segments of fricative consonants were measured. The spectral data were used as a basis for developing objective identification criteria which yielded fair results when tested. As a further check gated segments of fricatives were presented for identification to a group of listeners and their responses evaluated in terms of the objective identification criteria. A.

534.81

3588. TOUCH SENSITIVE KEYING DEVICES. B.F.Miessner.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1227 (Nov., 1955).

Reference is made to a paper by H.le Caine on "Touch-sensitive organ based on an electric coupling device". Attention is drawn to five prior patents by the author relating to keying devices. He considers a "pianistic" touch-responsive control of organ-tone dynamics constitutes a valuable improvement, particularly appreciated by pianists for whom the normal organ keyboard leaves so much to be desired. A.B.Wood

534.851 : 535.417

3589. NOTE ON THE CALIBRATION OF DISK RECORDING BY INTERFERENCE PATTERNS. P.E.Axon and W.K.E.Gedde
J. Acoust. Soc. Amer., Vol. 28, No. 1, 129 (Jan., 1956).

In commenting on a paper by B.B.Bauer (Abstr. 6864/1955) the authors emphasize that they described a similar technique in 1953 (Abstr. 5368/1953). They give brief details of a method of measuring the modulation on a recording disk by observing the interference patterns. The light patterns and fringes are situated in a focal plane not on the disk surface and calculations were made of the effect of diffraction on the distribution of light intensity near the theoretical edge of the pattern There is no abnormal restriction as to the lowest recorded amplitude which can be measured such as occurs in the American paper. Two sets of patterns are obtained in both cases. A.C.Whiffin

534.862 : 621.395.625.3

3590. APPARATUS FOR CHANGING THE PLAYBACK TIME OF A SOUND RECORDING. A.M.Springer.
Elektron. Rdsch., Vol. 9, No. 12, 418-20 (Dec., 1955). In German.

This technique is applicable to magnetic recording on tape. The apparatus consists of a group, preferably four, of rotating playback heads mounted symmetrically so that their gaps lie on the circumference of a circle. The tape speed is raised or lowered according to the degree of time extension or reduction required while the circumferential speed of the heads is adjusted so that the relative speed of tape and head is equal to the original recording speed. The tape passes round the group with an angle of wrap of 70°-90° and each head scans

the tape in turn. The head windings are connected in series and are connected through a pair of slip rings to the playback amplifier. Distortion arising when the distance between heads is an odd multiple of the recorded half wavelength is explained and a curve given for the optimum angle of wrap v. frequency for a 4-head assembly. In practical working a time extension of 70% and a time reduction up to 150% have been found possible. Brief mention is made of the use of this technique during recording. Several applications are given. H.G.M.Spratt (R)

OPTICS. RADIATION. SPECTRA 535

535.232

3591. SPECTRAL RADIANCE OF THE CARBON ARC FROM 1900 to 2500 ANGSTROMS. F.S.Johnson.
J. Opt. Soc. Amer., Vol. 46, No. 2, 101-3 (Feb., 1956).

The relative spectral radiance of the low-current carbon arc, which includes contributions from both the incandescent anode and the arc stream through which it is viewed, was measured from 1900 A to 2500 A and placed on an absolute scale by comparison with measurements made at longer wavelengths. The curve bears no resemblance to a blackbody curve in this spectral region, but has a minimum near 2400 A, increasing slowly to shorter wavelengths. The values near 2000 A are a little higher than those near 2500 A. The spectral radiance of the arc stream alone was also measured. A grating monochromator was used in the work, and the speed of the diffraction grating was measured separately by placing it in the exit beam of another grating monochromator. The receiver was a 1P21 photomultiplier sensitized for the ultraviolet by placing on its envelope a thick coating of sodium salicylate, a fluorescent material which possesses constant quantum efficiency for exciting wavelengths throughout this region. A.

535.3 : 534.21

INVESTIGATIONS ON THE PROPAGATION OF SIGNALS IN DISPERSING MEDIA WITH AN ACOUSTICAL MODEL.
See Abstr. 2738

535.315

3592. THE THEORY OF THE HÜFNER RHOMBUS. G.J. Ullrich.
Optik, Vol. 13, No. 3, 141-3 (1956). In German.

The author points out a correction to a previous paper by Mielenz (Abstr. 9543/1955) and deduces that a 30° prism is more favourable than the 45° prism earlier recommended. In a footnote Mielenz acknowledges the correction, modifies some of the equations of his previous paper but still maintains that the 45 prism has some advantages. R.W.Fish

535.317

3593. APPLICATION OF THE LEAST-SQUARES METHOD. S.Rosen and An Min Chung.
J. Opt. Soc. Amer., Vol. 46, No. 3, 223-6 (March, 1956).

The least-squares method for optical correction (Abstr. 6457/1954) is modified slightly. An "unsophisticated" bending is used, and this permits the use of lens separations a variables. Two applications of the least-squares procedure lead to a good simultaneous correction in all four pencils used. A.

535.317

3594. A PROCEDURE FOR THE DIFFERENTIAL CORRECTION OF OPTICAL SYSTEMS ALLOWING LARGE PARAMETER CHANGES. W.S.S.Blaschke.
Optica Acta, Vol. 3, No. 1, 10-23 (March, 1956).

A method of differential correction for optical systems is developed which serves in the coarser analysis of the aberrational characteristics of the system as well as in the final balance of residuals. Variations of optical paths through a general optical system due to relatively large constructional changes are considered, both at the changed refracting surfaces subsequent to them. The extra-axial meridional case is treated as well as the axial case. The technique is applied to two high numerical aperture microscope objectives suffering from the marginal and zonal unbalance normally associated with such objectives. A substantial change in the wavefront shapes is achieved, resulting in a much improved correction. A.

535.317.1

3595. INTRINSIC IMAGE-ERROR THEORY. M.Herzberger.
J. Opt. Soc. Amer., Vol. 46, No. 2, 132-8 (Feb., 1956).

Image-error theories are usually based on the coefficients of a characteristic function, and these coefficients are geometrically interpreted in the present paper. The choice of the characteristic function, particularly the choice of variables, is arbitrary. A normal bundle of rays is analysed here to obtain intrinsic error coefficients which have a geometrical significance, that is, which are independent of the variables used. The connections of these coefficients with the classical image-error theory, the theory of diapoints, the geometry of the caustic, the spot-diagram analysis, and the normal evaluation of the meridional-ray trace are analysed. This treatment is based on fifth-order theory since this is the simplest approximation having all the complexity of real optical systems. The interpretation of the sine condition and the Petzval condition in the light of these coefficients is explained. A.

535.317.1

3596. A NEW APPARATUS FOR OPTICAL IMAGE FORMATION WITH VARIABLE MAGNIFICATION SCALE AND AUTOMATIC FOCUSING. M.Kerner.
Optik, Vol. 13, No. 2, 65-73 (1956). In German.

Linkage systems for solving the lens equations are described in detail and a new system giving greater accuracy is suggested for use in enlargers etc. R.W.Fish

535.317.3/.5

3597. A NOTE ON THE EXTENSION OF THE PARAXIAL REGION OF IMAGE FORMATION. S.Mohorovičić.
Optik, Vol. 13, No. 3, 102-21 (1956). In German.

Hackl (Abstr. 824/1955) has suggested an extension of the paraxial region by substitution of a tangential plane for the refracting surface, with a fictitious refractive index. The present paper discusses this method and derives a computing schedule for use in lens design. The forms taken by the tangential equivalent refracting surface in special cases are calculated. R.W.Fish

535.317.5

3598. THE LIGHT DISTRIBUTION IN THE IMAGE OF A SLIT AS A FUNCTION OF THE 3RD-ORDER ABERRATIONS OF AN OPTICAL SYSTEM. R.Krieger.
Optik, Vol. 13, No. 2, 81-5 (1956). In German.

The light distribution is found by integration based upon the geometric ray paths of the lens. The equations are derived and the computational procedure outlined. R.W.Fish

535.317.6

3599. ON THE PROBLEM OF THE OPTICAL PATH LENGTHS OF TWO RAYS BETWEEN THE OBJECT AND THE INTERSECTION POINT OF THE TWO RAYS IN THE IMAGE SPACE. J.Picht.
Optica Acta, Vol. 3, No. 1, 1-9 (March, 1956). In German.

After some general remarks on optical paths, a calculation is made of the difference in path length, $\Delta w^2/H$, between an axial (principal) ray and a ray of inclination u' to their intersection point in the image space. Equations of the form: $\Delta s' = atg^2u' + btg^4u' + ctg^6u' + \ldots\ldots$ have been used to represent the wave-surface in presence of spherical aberration. Equations are then derived for the intersection curves with the meridian plane containing the principal ray of a pencil of rays in the presence of coma: $\Delta 1' = a_2tgK' + a_2tg^2K' + a_3tg^3K + \ldots$. From these equations the difference in optical path is again calculated between an oblique ray and the principal ray of a pencil in the presence of coma. A.

535.32

3600. CERTAIN ASPECTS OF DISPERSION IN SILICA GLASSES. A.Winter.
C.R. Acad. Sci. (Paris), Vol. 242, No. 5, 625-7 (Jan. 30, 1956). In French.

Values are given of $(n_D - 1)/(n_F - n_C)$ for SiO_2 glass containing various proportions of Li_2O, Na_2O, K_2O; MgO, CaO, SrO, BaO. It is shown that the results depend only on the periodic group and the molar concentration of the modifier ions. R.O.Davies

535.33.03 : 536.46

3601. FAR INFRARED EMISSION SPECTRUM OF FLAMES. ROTATIONAL SPECTRUM OF OH-RADICALS AND DETERMINATION OF FLAME TEMPERATURES. J.A.A.Ketelaar, C.Haas, F.N.Hooge and R.Broekhuijsen.
Physica, Vol. 21, No. 9, 695-700 (Sept., 1955).

The infrared emission spectra of flames of H_2—O_2, C_2H_2—O_2 mixtures and of hydrogen burning in air were studied in the KBr-region. The variation of intensities of a few bands with oxygen/burning-gas ratio led to these bands being distinguished as belonging to the OH-rotational spectrum. Flame temperatures calculated from this spectrum are consistent with the values obtained from ultraviolet band spectra. A.

535.33.07

3602. THE POSSIBILITY OF USING AN INCLINED SPHERICAL MIRROR. R.Grandmontagne.
C.R. Acad. Sci. (Paris), Vol. 242, No. 6, 753-5 (Feb. 6, 1956). In French.

The usual Littrow spectrograph uses a refracting objective. The aberrations arising from the substitution of a spherical mirror are calculated. While the aberrations are large owing to the very oblique incidence, they may be corrected by the use of an aspherical final mirror. R.W.Fish

535.33.07

3603. A NEW GRATING SPECTROGRAPH FOR THE SCHUMANN REGION WITH PHOTOELECTRIC RECORDING. E.Lüscher.
Helv. phys. Acta, Vol. 28, No. 5-6, 492-4 (1955). In German.

The 150 cm concave grating instrument is designed for industrial spectrography in the spectral region, 1200 to 2000 A. To record the Schumann emission lines, a layer of fluorescent calcium tungstate is coated on the window of the photomultiplier receiver. D.R.Barber

535.33.07

3604. SMALL GRATING SPECTROMETER FOR THE FAR INFRARED. A.Hadni.
J. Phys. Radium, Vol. 17, No. 1, 77 (Jan., 1956). In French.

The focal length of the collimator mirror is 10 cm, dimensions 4 x 4 cm, aperture F/2.5. The slits are 16 mm high and 0.5 to 1 mm wide. Two echelette gratings are used, with 8 and 4 lines per mm respectively, and a Schwarz thermopile as detector. Stray light is eliminated by selective modulations, Christiansen filters, selective reflection. C.Turner

535.331

3605. ENERGY LEVELS AND WAVELENGTHS OF NATURAL CADMIUM AND OF CADMIUM-114. K.Burns and K.B.Adams.
J. Opt. Soc. Amer., Vol. 46, No. 2, 94-9 (Feb., 1956).

In the region 8200-2144 A the wavelengths or vacuum wave-numbers of seventy-three lines in the first spectrum and eleven in the second spectrum of cadmium have been measured relative to neon standards or to the Hg^{198} spectrum or to both. The source for natural cadmium was a Beese lamp operated at 2.5-4.5 A. For Cd^{114} the source was either a quartz Michelson lamp (plus 1.0 mm argon) operated under standard conditions or at lower temperature, or an electrodeless tube containing 0.5 mg of Cd^{114}, 0.5 mg of Hg^{198}, and neon at 3 mm pressure. The use of Cd^{114} is preferable if the lines arising from S-P combinations are to be used as secondary standards. For P-D combinations the natural element is quite satisfactory. The characteristics of various sources are discussed. For the greater part of the observation required the interferometer was in vacuum; wave-numbers so observed are unaffected by the refractive index of air and its changes with temperature, pressure and constitution. The vacuum interferometer and Michelson lamp are described by Adams and Burns. (Abstr. 1128/1956). The wave-numbers of Hg^{198} measured by means of the vacuum interferometer have been compared with the wavelengths measured in air and converted to wave-numbers by Edlen's formula (Transactions of the Joint Commission for Spectroscopy, J. Opt. Soc. Amer., Vol. 43, 412, 1953). From 5790 to 2636 A the relative accuracy of the formula is confirmed. By differences in cadmium wave-numbers the formula is checked from 6438 to 2288 A. Edlen's formula is used throughout this paper wherever wave-lengths in air are converted to wave-numbers in vacuum or vice versa. A.

535.332/.333

3606. SPECTRA EMITTED FROM SOLID NITROGEN CONDENSED AT 4.2°K FROM A GAS DISCHARGE. A.M.Bass and H.P.Broida.
Phys. Rev., Vol. 101, No. 6, 1740-7 (March 15, 1956).

Products of an electrical discharge in flowing nitrogen are frozen at liquid helium temperatures. The solid material emits a glow. Emission spectra have been obtained in the region 2200 A to 7000 A. The most intense features of these spectra, five sharp lines near 5230 A and three diffuse lines between 5530 A and 5670 A, are attributed to radiation from nitrogen atoms as affected by the solid lattice. There is a less intense series of bands, degraded to the red, extending from 3500 A to 6400 A. This system most probably arises from a transition of the N_2 molecule, probably to the $A^3\Sigma_u^+$ state. In the same region there is a group of very weak diffuse bands which may be emission from NO_2. In addition several weak bands are attributed to the beta and gamma systems of NO and to NH. When the flow of nitrogen and the electrical discharge are removed, an afterglow from the solid is observed. The spectrum of the afterglow shows only the group near 5230 A and a weak line at 5944 A. The half-life of this afterglow radiation is about 15 seconds. Intensities of all other features decay to zero in less than one second. A.

535.333 : 535.343

3607. INFRARED ABSORPTION AND EMISSION SPECTRA OF CARBON MONOXIDE IN THE REGION FROM 4 TO 6 MICRONS. E.K.Plyler, L R.Blaine and E.D.Tidwell.
J. Res. Nat. Bur. Stand., Vol. 55, No. 4, 183-9 (Oct., 1955).

The infrared absorption and emission spectra of carbon monoxide and carbon dioxide have been measured with high resolution in the region from 4 to 6 microns. The measurements of the $C^{12}O^{16}$ fundamental band were carried out to a high precision, and a set of molecular constants calculated from the experimental data. In emission the 1-0 and 2-1 bands of CO were measured in the P branch. Twenty lines of $C^{13}O^{16}$ were measured in absorption, and the molecular constants calculated for this molecule. The fundamental band of CO_2 was found to have its centre at 2349.16, $B_0 = 0.390\,26 \pm 0.000\,05$, and $D_0 = 12.6 \pm 0.8 \times 10^{-8}$ cm^{-1}. A.

535.333

3608. THE FAR ULTRAVIOLET (C-X) BANDS OF N_2^+. P.G.Wilkinson.
Canad. J. Phys., Vol. 34, No. 3, 250-5 (March, 1956).

Emission bands of the N_2^+ C-X system in the vacuum ultraviolet have been obtained under high resolution. The rotational analysis confirms the assignment as a $^2\Sigma_u^+ \rightarrow {}^2\Sigma_g^+$ transition and the rotational constants obtained are in substantial agreement with previous investigations. The unusual intensity distribution in the $v' = 3$ progression and perturbations in the $v' = 0$, 1 and 2 levels of the C state are in agreement with the theory of inverse predissociation in the $v' = 3$ level. A.

535.333

3609. ULTRAVIOLET AND SCHUMANN SPECTRA OF THE NEUTRAL AND IONIZED MOLECULES PO, PS, NS, P_2. K.Dressler.
Helv. phys. Acta, Vol. 28, No. 5-6, 563-90 (1955). In German.

Ten new band systems have been observed in the u.v. and Schumann regions, using a Geissler discharge tube as light source. The new bands are attributed to the molecules PO, P_2, and to the formerly unknown molecule PS and the ions PS^+, NS^+, PO^+. The data on the molecular states involved are collected in table 10. The electronic structures of the molecules and ions are discussed and compared with those of isoelectronic molecules. A new vibrational analysis of the β-bands of PO ($B-X^2\Pi$) is carried out, and the vibrational and approximate rotational constants for the B state are evaluated. A short extrapolation of the B state levels as well as a predissociation limit observed in the E state lead to a determination of the heat of dissociation of PO ($D_0'' = 5.4$ eV). A.

535.338.3

3610. PHYSICAL BASIS OF LINE ENHANCEMENT IN ARGON AND KRYPTON. M.R.Baker, S.J.Adelstein and B.L.Vallee.
J. Opt. Soc. Amer., Vol. 46, No. 2, 138-40 (Feb., 1956).

The enhancement of certain metallic ion lines obtained from the d.c. arc in atmospheres of argon, krypton, and helium has been examined. The ratios of the intensities of these lines in argon to their intensities in helium and krypton are maximal for those whose excitation potentials (E.P.) lie in the vicinity of the E.P. of the lower excited energy levels of argon. This observation is accounted for by the following mechanism: The noble gas is energized to its lowest excited levels by the arc discharge through collisions of the second kind. This energy is transferred to neutral metal atoms volatilized in the arc. The metal atoms are thus ionized and excited; they then fall to the ground state emitting their characteristic radiation. The maximum energy is transferred from argon to metal atoms when the energy of the excited noble gas atom equals the E.P. of the metal ion line, resulting in the selective enhancement observed. A.

535.338.3

3611. THE EFFECT OF CONFIGURATION INTERACTION ON FORBIDDEN LINE STRENGTHS. R.H.Garstang.
Proc. Cambridge Phil. Soc., Vol. 52, Pt 1, 107-13 (1956).

The calculation of the strengths of forbidden lines in the $1s^22s^22p^2$ configuration is extended to include the effect of interaction with the $1s^22p^4$ configuration. For this case it is shown that if observed energy levels are used instead of theoretical energies in line-strength formulae which neglect configuration interaction the major part of the effect of configuration interaction is nevertheless taken into account. The results are illustrated by detailed computations on the Ca XV spectrum. The $1s^22s^22p^4$ configuration is also discussed. A.

535.338.32 : 539.155.2 : 535.51

3612. POLARIZATION OF THE OPTICAL RESONANCE OF THE ISOTOPE 198 OF MERCURY. N.Rollet, J.Brossel and A.Kastler.
C.R. Acad. Sci. (Paris), Vol. 242, No. 2, 240-2 (Jan. 9, 1956). In French.

Mercury vapour at a range of known pressures was illuminated by a beam of 2537 A radiation parallel to a magnetic field, and the resonance radiation measured, at 90° to this direction, for degree of polarization. For ordinary mercury the theoretical value is 73.5% and the maximum observed was 69% at a pressure corresponding to about 10^{12} atoms/cm^3, with a gradual fall to about 35% at 1.5×10^{13} atoms/cm^3. For Hg^{198} containing less than 2% Hg^{199} the theoretical maximum is 100% and the maximum observed was 96%, with a fall to 20% over the same pressure range. The more rapid fall for the pure isotope is attributed to its higher absorption coefficient for the radiation. S.T.Henderson

535.338.333

3613. ISOTOPE EFFECT IN THE SPECTRUM OF INDIUM I. D.A.Jackson.
Phys. Rev., Vol. 101, No. 4, 1425-6 (Feb. 15, 1956).

Gives details of the measurements of isotope shifts in 5 lines of indium. The latter was either natural or enriched in In^{113}. A discussion of the errors of measurement is given. J.D.Craggs

535.343 : 539.132

3614. INTERPRETATION OF THE LOWEST FREQUENCY ELECTRONIC ABSORPTION BANDS OF INORGANIC MOLECULES OF TYPE $XO_y^{z(-)}$ AS $n \rightarrow \pi^*$ TRANSITIONS. S.P.McGlynn and M.Kasha.
J. chem. Phys., Vol. 24, No. 2, 481-2 (Feb., 1956).

Qualitative treatment using LCAO-MO theory of the lowest transitions in the electronic spectra of some non-metallic and transition element oxides and sulphides and their negative ions with y = 1, ..4 and z = 0, ..3. Many of these transitions can be interpreted as being from non-bonding (n) orbitals arising from O (or S) $2p\pi$ AO's to anti-bonding (π^*) orbitals arising mainly from the central (X) atom AO's. Reasonable correlation is obtained between the predicted selection rules and the observed intensities, and between the order of the frequencies of the transitions and the reverse order of the Mulliken electronegativity of X (see Abstr. 9462/1954). J.Hawgood

535.343

3615. FAR ULTRAVIOLET ABSORPTION SPECTRA OF ETHYLENE AND ETHYLENE-d_4. P.G.Wilkinson and R.S.Mulliken.
J. chem. Phys., Vol. 23, No. 10, 1895-907 (Oct., 1955).

These spectra have been reinvestigated in the 1500 A to 2050 A region, using the first order of the Harrison 21 foot vacuum spectrograph. Vibrational constants of the C=C stretching vibration in the R (first Rydberg) state were determined to be: C_2H_4, $\omega_2^0 = 1381.5$ cm^{-1}; $\omega_{22}^0 = -11.2$ cm^{-1}; C_2D_4, $\omega_2^0 = 1306.8$ cm^{-1}; $x_{22}^0 = 8.2$ cm^{-1}; and (tentatively) in the V state: C_2H_4, $\omega_2^0 = 852$ cm^{-1}; $x_{22}^0 = -1.9$ cm^{-1}; C_2D_4, $\omega_2^0 = 797$ cm^{-1}; $x_{22}^0 = 1.8$ cm^{-1}. Newly observed fine structure in the $v' - 0$ stretching vibration progression in the long wavelength part of the V ← N transition of C_2D_4 is tentatively attributed to a torsional oscillation. The 0—0 bands of the V ← N transition, though too weak to be seen, were estimated to lie near 2500 A. The probable dissociation of ethylene into CH_2 radicals in the V ← N continuum is discussed. The torsional frequency in the R state was redetermined as 141 cm^{-1} (C_2D_4) and 236 cm^{-1} (C_2H_4), decreasing somewhat with increasing stretching quantum number. An attempt has been made to fit the corresponding vibrational levels, for both isotopes, to those calculated for a torsional oscillator-rotator using a potential function of the form $V = \frac{1}{2}V_0(1 + \cos 2\theta)$. Rough agreement is obtained for a reasonable barrier height of about 790 cm^{-1}. (Values of 650 cm^{-1} for C_2D_4 and 920 cm^{-1} are obtained when the two isotopes are treated separately.) The anomalous isotope effect and intensities in the R ← N twisting bands are tentatively attributed to perturbation of the R state levels by V state levels and/or the departure of the twisting potential from the simple cosine form. These views are encouraged by the fact that a higher Rydberg state shows similar twisting bands but with much less anomalous isotope effect and intensities. A.

535.343

3616. INTERMOLECULAR EFFECTS IN NAPTHALENE CRYSTAL SPECTRA. D.P.Craig and J.R.Walsh.
J. chem. Phys., Vol. 24, No. 2, 471-2 (Feb., 1956).

The methods of Abstr. 5322/1955 are applied to a calculation of the effects of dipole-dipole interactions on the band systems at 2750 and 2200 A, giving results similar to those for anthracene. The 2200 system is assigned to A_g-B_{3u}, long axis polarized, and that at 2750 to A_g-B_{2u}, short axis polarized. J.Hawgood

535.343 : 535.329

3617. STUDY OF THE ABSORPTION OF RESIDUAL RAYS AND OF "MISSING" RAYS OF CuI AT 77°K IN THE VISIBLE SPECTRUM. S.Nikitine and R.Reiss.
C.R. Acad. Sci. (Paris), Vol. 242, No. 2, 238-40 (Jan. 9, 1956). In French.

The reflection spectrum of a thin plate of CuI shows a sharp minimum, "rayons manquants", at shorter wavelengths than the absorption line. The phenomenon arises from anomalous dispersion. R.F.Barrow

535.343

3618. INTENSITY AND WIDTH OF ABSORPTION LINES OR BANDS IN THE INFRARED. J.Vincent-Geisse.
J. Phys. Radium, Vol. 17, No. 1, 63-71 (Jan., 1956). In French.

A review, with 95 references, of methods of measuring these quantities. Measurements of line width are only approximate and of secondary interest. Uses of intensity measurements are: (1) comparison with calculated values may assist in assignments, (2) calculation of electric moments, (3) estimation of constitution, temperature and pressure of solar and terrestial atmospheres, (4) quantitative analysis.
G.F.Lothian

535.343 : 548.0

3619. THE OH BAND OF HAMBERGITE. A.M.Vergnoux.
C.R. Acad. Sci. (Paris), Vol. 242, No. 6, 758-60 (Feb. 6, 1956). In French.

The OH band at 6800 cm^{-1} is measured in the three main crystal-directions. The absorption is largest in the c-direction. The band is slightly broadened and displaced with respect to the 'free' absorption. This is due to hydrogen bonding. The site of the hydrogen in the crystal structure is calculated from the absorption coefficient. C.Turner

535.343

3620. RESOLUTION OF ν_{11}(E) OF ALLENE AT 28 μ. K.Narahari Rao and E.D.Palik.
J. chem. Phys., Vol. 23, No. 11, 2112-13 (Nov., 1955).

The perpendicular band of allene at 28 $\mu(\nu_{11})$ was resolved for the first time. The average separation between successive Q branches, which represents essentially

$$2[A_{V'}(1-\zeta_y) - B_{V'}]_{V=11}$$

is found to be 1.2 ± 0.2 cm^{-1}. A.

535.343 : 539.132

3621. INFRARED SPECTRUM AND MOLECULAR CONSTANTS OF CD_4. H.M.Kaylor and A.H.Nielsen.
J. chem. Phys., Vol. 23, No. 11, 2138-52 (Nov., 1955).

The infrared spectrum of CD_4 has been examined from 900 cm^{-1} to 8500 cm^{-1}. A total of twenty-eight bands were observed, including four originally measured by Nielsen and Nielsen under somewhat lower resolving power. Twenty-three bands were attributed to CD_4, two to CD_3H, two to CH_4 and one was unassigned. With the aid of the band centres of the corresponding fundamentals in CH_4, the following vibrational constants of CD_4 were obtained: the normal frequencies $\tilde{\omega}_1 = 2143.2$, $\tilde{\omega}_2 = 1109.4$, $\tilde{\omega}_3 = 2336.8$, $\tilde{\omega}_4 = 1026.8$ cm^{-1}; the harmonic potential energy constants $k_1 = 2.093 \times 10^5$, $k_2 = 2.841 \times 10^5$, $k_3 = 8.463 \times 10^5$, $k_4 = 2.790 \times 10^5$, $k_5 = 1.329 \times 10^5$ dynes/cm. From the rotational analysis of nine bands, the B values of upper states for these modes of vibration were found as well as the following rotational constants: the vibration-rotation interaction constants $\alpha_1 = -0.017$, $\alpha_2 = -0.015$, $\alpha_3 = 0.014$, $\alpha_4 = 0.017$ cm^{-1}; $B_0 = 2.591$ cm^{-1}; $B_e = 2.614$ cm^{-1}; $I_e = 10.70 \times 10^{-40}$ g-cm^2; $r_{C-D} = 1.095 \times 10^{-8}$ cm; $r_{D-D} = 1.788 \times 10^{-8}$ cm^{-1} and the moduli of the internal angular momentum $\zeta_3 = 0.14_8$, $\zeta_4 = 0.35_8$. A.

535.343

3622. TEMPERATURE DEPENDENCE OF INFRARED ABSORPTION. R.H.Hughes, R.J.Martin and N.D.Coggeshall.
J. chem. Phys., Vol. 24, No. 2, 489-90 (Feb., 1956).

Measurements of OH and CH stretching vibrations of a number of compounds in dilute solution show decreasing intensity of absorption at increasing temperature. This may be due to the effects of smaller force fields due to increasing distances between molecules at higher temperatures.
G.F.Lothian

535.343 : 535.372

3623. POLARIZED ABSORPTION AND FLUORESCENCE SPECTRA OF CRYSTALLINE ANTHRACENE AT 4°K: SPECTRAL EVIDENCE FOR TRAPPED EXCITONS. J.W.Sidman.
Phys. Rev., Vol. 102, No. 1, 96-101 (April 1, 1956).

The long-wavelength absorption and fluorescence spectra of anthracene crystal have been examined in the ab (cleavage) plane at 4°K. The spectra are compared with those reported previously, and are related to the spectra of the solid solution. The spectra of the crystal and the mechanism of the fluorescence process are interpreted in terms of Frenkel's theory of free and trapped excitons. The relative shift of the electronic transition in the vapour, mixed crystal, and pure crystal is related to the possibility of detecting trapped exciton states in molecular crystals. A.

535.343 : 535.375.55

3624. VIBRATIONAL SPECTRA OF ETHYLENE OXIDE AND ETHYLENE OXIDE-d_4. R.C.Lord and B.Nolin.
J. chem. Phys., Vol. 24, No. 4, 656-9 (April, 1956).

The infrared spectra of gaseous ethylene oxide and ethylene oxide-d_4 in the range 375-3800 cm^{-1} and the Raman spectra of the liquids have been determined. With the help of the infrared band contours and the product rule, a complete vibrational assignment has been made for both molecules. The assignments correlate well with those of cyclopropane and cyclopropane-d_6. A.

535.343 : 541.183

3625. INFRARED SPECTRA OF CHEMISORBED OLEFINS AND ACETYLENE. W.A.Pliskin and R.P.Eischens.
J. chem. Phys., Vol. 24, No. 2, 482-3 (Feb., 1956).

The spectra indicate the absence of a C=C bond. Treatment with hydrogen modifies the spectrum to indicate the presence of $-CH_2CH_3$. G.F.Lothian

535.343

3626. MICROWAVE SPECTRA OF THE FREE RADICALS OH AND OD. G.C.Dousmanis, T.M.Sanders, Jr and C.H.Townes.
Phys. Rev., Vol. 100, No. 6, 1735-54 (Dec. 15, 1955).

Experiments are reported on the microwave spectra of the free OH radical. The radicals are produced by an electric discharge in concentrations near 10% at pressures of approximately 0.1 mm Hg. The spectra are detected by Zeeman modulation. They are due to direct transitions between the Λ-doublet levels of each rotational state in the ground vibrational level of the molecule. Spectra due to $O^{16}H$, $O^{16}H$ and $O^{16}D$ in $\Pi_{1/2}$ and $\Pi_{3/2}$ states have been observed in the 7.7 to 37 kMc/s region. Intensity of the lines ranges from about 5 x 10^{-8} cm^{-1} to 5 x 10^{-8} cm^{-1}. Van Vleck's theory of molecular energies in $^2\Pi$ and $^2\Sigma$ states is extended to include terms of order $(E_{rot}$ or $E_{fs})^2/E_{el}^2$. The experimental results are in agreement with theoretical expectations to about one part in 2000 which is the order of accuracy of the theory. An improved agreement (to one part in 3500) is obtained if one allows a small variation (one part in 1400) of the electronic wave-function from one rotational state to the next. The values of the molecular constants determined from the Λ-type doubling data are

$$4 \sum_{\Sigma\text{-states}} (-1)^S \langle \Pi | AL_y + 2BL_y | \Sigma \rangle \langle \Sigma | BL_y | \Pi \rangle / (E_\Sigma - E_\Pi)$$

= −2361.37 ± 2.95 Mc/s in $O^{16}H$
and −1548.99 ± 2.10 Mc/s in $O^{16}D$;

4 $\Sigma(-1)^S|(\Pi|BL_y|\Sigma|^2/(E_\Sigma - E_\Pi) = 576.18 \pm 1.64$ Mc/s
Σ-states

in $O^{16}H$ and 161.94 ± 1.61 Mc/s in $O^{16}D$; $A/B = -7.444 \pm 0.017$ in $O^{16}H$ and -13.954 ± 0.032 in $O^{16}D$. The spectra include magnetic hyperfine structure from which the following values are obtained for parameters that describe the unpaired electron distribution in the molecule:

$$(1/r^3)_{Av} = (0.75 \pm 0.25) \times 10^{24} \text{ cm}^{-3}$$

and

$$(\sin^2\chi/r^3)_{Av} = (0.49 \pm 0.01) \times 10^{24} \text{ cm}^{-3}.$$

The hyperfine structure, the molecular magnetic moment and the line intensities are strongly dependent on the extent of intermediate coupling in agreement with theoretical expectations. The microwave spectrum can be used in studying chemical properties of the radical. Its lifetime was determined to be near ⅓ sec, and the effects of certain substances on radical concentration were examined. A.

535.343

3627. ABSORPTION SPECTRUM OF FORMIC ACID VAPOUR NEAR 3 mm WAVELENGTH. R.Wertheimer.
C.R. Acad. Sci. (Paris), Vol. 242, No. 2, 243-4 (Jan. 9, 1956). In French.

Seven absorption lines between 86 000 and 94 000 Mc/s in the absorption of formic acid are identified as particular J_{3-4} transitions and lead to $B_0 = 12\,054.8$ Mc/s, $C_0 = 10\,416.1$ Mc/s, asymmetry parameter −0.0124. D.H.Whiffen

535.343

3628. PASSING OF THE CRITICAL FREQUENCY OF A HYDROXYL GROUP FROM THE HERTZIAN REGION TO THE INFRARED VIBRATION FREQUENCIES OF O–H.
P.Abadie, R.Charbonnière, A.Gidel, P.Girard and A.Guilbot.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 1016-17 (Feb. 20, 1956). In French.

For many alcohols, sugars, starch etc. the critical frequency of dielectric loss can be expressed as $f_C = A \exp.(-H/kT)$ where A is nearly constant at about 10^{13} to 10^{14} c/s for all compounds. This frequency corresponds to infrared absorption if H = 0. D.H.Whiffen

535.343

3629. THE MICROWAVE HYPERFINE SPECTRUM OF FORMALDEHYDE. A.Okaya.
J. Phys. Soc. Japan, Vol. 11, No. 3, 258-63 (March, 1956).

A hyperfine structure of the $4_{1,4} \rightarrow 4_{1,3}$ transition in the microwave spectrum of formaldehyde has been observed. The observed hyperfine features are mainly explained in terms of the interaction of the magnetic moments of the protons with the molecular rotational magnetic field. The main absorption lines were composed of three strong lines with total quantum numbers F = 3, 4 and 5 respectively. The determined splitting frequency between the F = 5 and the F = 3 lines was 188 ± 15 kc/s. For a detailed explanation of this value, further information on electronic and magnetic properties of this molecule is required. A.

535.343

3630. ABSENCE OF RADIO FREQUENCY RESONANCE ABSORPTION IN TRIETHYLAMINE. J.S.Dryden and R.J.Meakins. Addendum by M.Davies and A.H.Price.
Proc. Phys. Soc. B, Vol. 69, Pt 2, 252-4 (Feb., 1956).

States that the supposed inversion resonance of triethylamine (Abstr. 8259/1954) at 10^8 c/s is due to experimental error. This is confirmed by the original investigators in an addendum. D.H.Whiffen

535.343 : 539.133

3631. MICROWAVE SPECTRUM AND MOLECULAR STRUCTURE OF $(CH_3)_3SiBr$. J.F.Ollom, A.A.Sinisgalli, H.N.Rexroad and R.C.Gunton.
J. chem. Phys., Vol. 24, No. 2, 487-8 (Feb., 1956).

Measurements of high-J rotational lines for both Br isotopes show that this molecule has symmetric-top behaviour, like the Cl and F analogues (Abstr. 668/1954, 1702/1955). Assuming d(CH) = 1.093 A and tetrahedral HCH and CSiC angles, calculations give d(SiC) = 1.81 ± 0.02 A and d(SiBr) = 2.24 ± 0.02 A. J.Hawgood

535.345

3632. INFRARED TRANSMITTANCE OF SOME CALCIUM ALUMINATE AND GERMANATE GLASSES. J.M.Florence, F.W.Glaze and M.H.Black.
J. Res. Nat. Bur. Stand., Vol. 55, No. 4, 231-7 (Oct., 1955).

The infrared transmittance of some calcium aluminate and germanate glasses has been measured out to 6 microns. The range of compositions of the calcium aluminate glasses was CaO, 26.7 to 52.0%, and Al_2O_3, 28.2 to 49.6%. Barium oxide, BeO, Bi_2O_3, La_2O_3, MgO, and PbO were added in varying amounts up to a maximum of 36.0% for any one constituent. These calcium aluminate glasses are good infrared transmitters, but show a prominent water absorption band at 2.9 to 3.0 microns. This absorption can be decreased somewhat by means of a dry air treatment of the melt. These glasses have a strong tendency toward devitrification. Germanium oxide is a good glass-former. Its glasses have about the same infrared transmittance as the calcium aluminate glasses in the absence of oxides such as SiO_2 and BeO, which absorb in the 4.5- to 5.5-micron region. A.

535.35 : 535.338.4

3633. SUPERELASTIC COLLISIONS AND APPARENT TRANSITION PROBABILITIES: THE CASE OF PURE NITROGEN. H.Schram, L.Herman and R.W.Lunt.
C.R. Acad. Sci. (Paris), Vol. 242, No. 5, 623-5 (Jan. 30, 1956). In French.

The variation with electron concentration of the intensity ratio of the systems $C^3\Pi_u - B^3\Pi_g$ and $A^3\Sigma_u^+ - X^1\Sigma_g^+$ has been studied. Qualitative results on the deactivation of state A have been obtained. Deactivation of state C takes place by collision with $N(^4S)$ to give $N_2(B) + N(^2P)$. R.F.Barrow

535.371

3634. ON THE FLUORESCENCE OF P-CHLOROTOLUENE IN THE SOLID STATE AT LOW TEMPERATURES.
S.C.Sirkar and D.C.Biswas.
J. chem. Phys., Vol. 24, No. 2, 470 (Feb., 1956).

535.371

3635. STUDY OF ORGANIC SCINTILLATORS.
R.C.Sangster and J.W.Irvine, Jr.
J. chem. Phys., Vol. 24, No. 4, 670-715 (April, 1956).

The scintillation counting behaviour of a group of fifty-five pure crystalline organic compounds has been extensively studied. The data obtained have been analysed with the aim of developing a better understanding of the scintillation process and of scintillator behaviour. The materials were carefully purified, and massive crystals were grown. Relative scintillation average-pulse-height efficiencies at 30° C and −70° C for cobalt-60 gamma-ray excitation, gamma-ray excited scintillation decay times, and 2537 A ultraviolet-excited reflection and transmission photofluorescence spectra have been determined. A few solutions were also studied for comparison purposes. The purification and properties of the different materials are discussed in detail. The experimental data have been analysed on the basis of Birks' photon cascade theory of the scintillation process. The ratio of the scintillation efficiency to the integrated photofluorescence intensity is shown to be a measure of Birks' primary photon production efficiency. The primary photon efficiencies vary over a relatively narrow range, so that there is a rough general correlation between the scintillation efficiencies and the integrated photofluorescence intensities. The best phosphors are those with rigid molecular and crystal bonding so that both the primary photon production and photofluorescence efficiencies are reasonably high. There is a tendency for the best scintillators to have the simplest and most sharply defined photofluorescence spectra. The scintillation efficiencies have been correlated with molecular structures

and the mobility of the π electrons (or with the resonance interactions) within the molecules. In the simpler cases, consideration of singly charged quinoid structures permits the calculation of parameters which can be directly correlated with the scintillation efficiencies. In more complex cases, steric hindrance, hyperconjugation, "unshared" and "nonbonding" electron pairs, five-membered aromatic rings, heavy atom (triplet-state) effects, and quinoid (quenching) ground states must be considered. In all cases, the effects of thermal (vibrational) perturbations are present. "Bond density" and "bound valence" values have proved to be useful in correlating scintillation phenomena and molecular structure effects. Strongly coloured compounds are usually poor scintillators. Earlier predictions of high scintillation efficiency for quinquephenyl and sexiphenyl are reaffirmed, and coronene, benzo[ghi]-perylene, and 1, 2, 5, 6-dibenzanthracene are also predicted to be significantly better than the presently known organic scintillators. The further study of compounds containing five-membered aromatic rings appears promising. A generally good correlation has been found between the scintillation efficiencies and molecular diamagnetic anisotropy values. Some relationships between the scintillation decay times and the molecular structures can also be seen. The best crystalline organic scintillators are colourless substances of high melting point possessing molecules of simple structure and low atomic number in which there is extensive resonance conjugation of rings, ethylenic double bonds, and other groups to give extended, rigidly interlocked systems. A.

535.371

3636. ASSOCIATED DONOR–ACCEPTOR LUMINESCENT CENTERS. J.S.Prener and F.E.Williams.
Phys. Rev., Vol. 101, No. 4, 1427 (Feb. 15, 1956).

Simultaneous addition of activators and co-activators to ZnS-type phosphors results in a transfer of electrons from donor levels to acceptor levels in the crystal, the impurities involved then being oppositely charged. This also increases activator solubility. Interaction between activators and co-activators leads to non-random distribution of both. Nearest-neighbour associations have no normal donor–acceptor states but discrete states 10^{-4} eV from the valence and conduction band limits. These levels may explain "edge" emission in such phosphors. Normal emission bands are associated with transitions between 2nd and 3rd nearest neighbours.

G.F.J.Garlick

535.375.54

3637. SELECTION RULES AND TEMPERATURE DEPENDENCE OF THE FIRST-ORDER RAMAN EFFECT IN CRYSTALS. O.Theimer.
Canad. J. Phys., Vol. 34, No. 3, 312-38 (March, 1956).

Starting from the most general scattering formulae, the current theory of the Raman effect in crystals is modified in such a way as to remove the well-known discrepancies between theory and experiment concerning the selection rules for calcite and similar crystals. A distinction is made between electrons in delocalized crystal orbitals and electrons in localized atomic or molecular orbitals and it is shown that only the latter produce a Raman scattering in agreement with the unmodified theory. The general formula for the scattering by delocalized electrons is analysed and it is found that the magnitude of the components

$$\left[(\partial\alpha_{\rho\sigma}/\partial q_j)_o q_j\right]_{v_j+1}^{v_j}$$

of the first-order polarizability (q_j normal coordinate of the scattering lattice vibration) depends on the wave vectors Q' and Q'' of incident and scattered light. The wave-vector dependence of the first-order polarizability requires selection rules for the first-order Raman effect which do not correspond to the full symmetry of the scattering crystal but only to the symmetry operations of the group of $Q = Q' - Q''$ which leave Q unchanged. These modified selection rules are shown to be compatible with experiment. The influence of mechanical anharmonicity and of polarizability derivatives of higher order on the first-order Raman effect is also discussed. It is found that these non-linear effects offer no satisfactory explanation for the great intensity of forbidden lines in the Raman spectrum of some crystals. Concerning temperature effects the non-linear terms in the intensity formulae are found to be of greater importance and are tentatively suggested as being responsible for the anomalous temperature dependence of low frequency external lattice vibrations. A.

535.375.54

3638. RAMAN SPECTRUM OF CESIUM BROMIDE. P.S.Narayanan.
Proc. Indian Acad. Sci. A, Vol. 42, No. 6, 303-8 (Dec., 1955)

CsBr crystallizes with CsCl structure. The spectrum was studied using the resonance radiation of mercury as exciter, and consists of a number of lines very close to the exciting line of which five prominent frequency shifts are 79, 107, 135, 155 and 190 cm^{-1}. A calculation of the 7 distinct frequencies of CsBr using the approximate formulae worked out by K.G.Ramanathan on the basis of Raman's theory has been carried out and an attempt made to explain the prominent features of the observed spectrum. A.

535.376

3639. ACTION OF TEMPERATURE ON THE ELECTRO-LUMINESCENCE OF SULPHIDES. J.Mattler.
J. Phys. Radium, Vol. 17, No. 1, 42-51 (Jan., 1956). In French.

A number of electroluminescent sulphides are examined over the range $-155^{\circ}C$ to $+155^{\circ}C$, the behaviour being dependent on phosphor constitution and conditions of preparation. Modification of emission spectra also occurs at low temperatures. G.F.J.Garlick

535.376

3640. CONTRIBUTION TO THE STUDY OF THE EXTINGUISHING AND SENSITIZING EFFECTS OF ELECTRIC FIELDS. H.E.Gumlich.
J. Phys. Radium, Vol. 17, No. 2, 117-21 (Feb., 1956). In French.

A comparison of the results observed for ZnS.CdS.Mn when the phosphor is subjected to an a.c. field superimposed on a prior excitation by ultraviolet or, alternatively, by X-rays. For constant ultraviolet the applied field decreases the mean level of luminescence, and with increasing field the level continues to decrease and the wave-forms of the light output become more unsymmetrical. On the other hand, for constant X-rays the field increases the luminescence with little or no change of the wave forms. Some transitory effects are mentioned. S.T.Henderson

535.376

3641. ELECTROLUMINESCENCE IN DISORDERED ZINC SULPHIDE. M.A.Short, E.G.Steward and T.B.Tomlinson.
Nature (London), Vol. 177, 240-1 (Feb. 4, 1956).

It is suggested from single-crystal experiments that electroluminescence processes are related to one-dimensional stacking disorders, the copper activator diffusing into the whole crystal but giving electroluminescence only when in the disordered surroundings. G.F.J.Garlick

535.376

3642. FREQUENCY DEPENDENCE OF ELECTROLUMINESCENT BRIGHTNESS. C.H.Haake.
Phys. Rev., Vol. 101, No. 1, 490-1 (Jan. 1, 1956).

See Abstr. 2003 (1956). It is shown that the field frequency dependence of electroluminescence must be investigated together with the temperature dependence of electroluminescence since the frequency dependence can be shown to depend on the escape frequency of trapped electrons which is strongly temperature dependent. G.F.J.Garlick

535.376

3643. ELECTROLUMINESCENCE IN ZINC SULFIDE. W.A.Thornton.
Phys. Rev., Vol. 102, No. 1, 38-46 (April 1, 1956).

A simple theory, based upon a single-level trapping and field-controlled thermal release process, predicts detailed dependences of electroluminescence light output wave form and integrated light output on voltage, frequency and temperature. Extensive data, obtained with the use of zinc sulphide phosphor powder layers, are in close agreement with the theory. Negligible frequency dependence of integrated light output at low fields and low temperatures and the usual strong dependence at higher fields are predicted and experimentally confirmed. Small temperature dependence, over a wide range of temperatures, at high fields and low frequencies, and strong dependence at lower fields, are predicted and observed; this explains the fact that both strong and weak temperature dependences are reported in the literature. Further correlations, together with the associated data, are presented. A.

535.39

3644. REFLECTION BY SEMI-INFINITE DIFFUSERS. R.G.Giovanelli.
Optica Acta, Vol. 2, No. 4, 153-62 (Dec., 1955).

Total and directional reflectances are derived and tabulated for semi-infinite diffusers with matrices of various refractive indices and scattering according to the phase function $\omega_0(1 + x \cos \theta)$. A.

535.39 : 535.88

3645. THE MEASUREMENT OF REFLECTION COEFFICIENT OF SOME NEW PROJECTION SCREENS. H.Jensen.
Optik, Vol. 13, No.2, 74-8 (1956). In German.

Polar reflection diagrams are given for 15 different screens used for film projection. They include metallized, bead and figured screens. The method of measurement is described and a brief discussion of desirable screen properties given. R.W.Fish

535.39 : 539.234

3646. EXTENSION OF THE APPROXIMATE EQUATIONS FOR THE OPTICAL ANALYSIS OF THIN FILMS. J.F.Hall, Jr.
J. Opt. Soc. Amer., Vol. 46, No. 2, 142-3 (Feb., 1956).

A previous theory (Abstr. 8621/1955) is extended to include the optical analysis of thin films for which the refractive index is less than that of the substrate. R.A.Weale

535.417 : 531.715.15

3647. THE SHOWING OF THE DEGREE OF PLANENESS OF A HIGH POLISH BY MEANS OF SURFACE TOPOGRAPHY. R.Segeletz.
Optik, Vol. 13, No. 2, 59-63 (1956). In German.

A description of the best method for revealing clearly the topography of a large "flat" as derived from interference fringe patterns. The method of computing the complexities of the topography in terms of contour lines 0.01μ apart is discussed. These contour lines are derived from ordinary fringe patterns. S.Tolansky

535.417 : 531.717

3648. THE MEASUREMENT OF THE THICKNESS OF THIN OBJECTS WITH AN INCIDENT-LIGHT INTERFERENCE MICROSCOPE. G.Schulz.
Naturwissenschaften, Vol. 43, No. 2, 31-2 (1956). In German.

A description is given of a Michelson-type interferometer with a microscope objective in the aperture which enables the thickness of opaque thin bodies to be measured. In essence the arrangement measures the location successively of the planes from the front and back of the object with respect to a reference mirror in the Michelson interferometer system. The separation between the front and back surface is thus secured even for completely opaque bodies. S.Tolansky

535.417 : 535.345.6

3649. COUPLED INTERFERENCE FILTER. U.Gradmann.
Optica Acta, Vol. 3, No. 1, 30-5 (March, 1956). In German.

Simple interference filters consist of two parallel metallic layers alternating with dielectrics. For systems of more than two parallel metallic layers, i.e. when several simple filters are placed in series, their transmissions are not simply multiplied, but coupling effects appear. Formulae are given and discussed for the spectral variation of the transmission factors for filters of 2, 3 and 4 metallic layers. Diagrams are given of calculated numerical examples. A.

535.42

3650. TRANSFER FUNCTION FOR AN ANNULAR APERTURE. E.L.O'Neill.
J. Opt. Soc. Amer., Vol. 46, No. 4, 285-8 (April, 1956).

A method of evaluating the two-dimensional Fourier transform of the point image intensity distribution for an annular aperture is presented. Since all three integrals involved are of the same basic form, it is shown that an analytic solution can be obtained by integrating the general expression with respect to a parameter. The result agrees with Steel's expression obtained by convolving the aperture function with its complex conjugate. A family of transfer functions is then plotted with the ratio of inner to outer radius of the annulus as a parameter. A.

535.42 : 534.321.9

3651. ON THE DIFFRACTION OF LIGHT BY PROGRESSIVE AND STANDING SUPERSONIC WAVES. R.Mertens.
Proc. Indian Acad. Sci. A, Vol. 42, No. 4, 195-8 (Oct., 1955).

It has been shown that the following property of the spectrum of the diffraction of light by ultrasonic waves, in which orders higher than the first are missing, can easily be deduced from the generalized theory of Raman and Nath if ρ is much greater than 1: the intensity of the first orders in the case of standing sound waves has half the value of the intensity of the same orders in the case of progressive sound waves. A.

535.43

3652. RADIATIVE TRANSFER IN TWO DIMENSIONS. J.T.Jefferies.
Optica Acta, Vol. 2, No. 4, 163-7 (Dec., 1955).

A first approximation is obtained for the distribution of intensity in a semi-infinite scattering medium illuminated by normally incident radiation whose flux is an arbitrary function of one Cartesian coordinate in the boundary plane. A.

535.43

3653. THE INTENSITY AT THE SURFACE OF A SEMI-INFINITE DIFFUSER WITH AN INFINITE LINE SOURCE PARALLEL TO THE SURFACE. R.G.Giovanelli.
Optica Acta, Vol. 3, No. 1, 24-9 (March, 1956).

Equations are developed for the intensity distribution at the surface of a semi-infinite isotropically scattering diffusing medium whose matrix may be of refractive index unity or greater, the source being a line lying on the surface; numerical solutions are given for several values of the albedo for single scattering and hence of the reflectance. An extension of the argument leads to formal solutions for the intensity distribution for line sources below the surface. A.

535.43 : 548.7

3654. TEMPERATURE DEPENDENCE OF COHERENT LIGHT SCATTERING IN MONOCRYSTALS AND INTRINSIC BLOCK STRUCTURE. R.Fürth.
Proc. Phys. Soc. B, Vol. 69, Pt 2, 255-6 (Feb., 1956).

It is shown that the proportionality between temperature and intensity of scattered light at 90°, found by Taurel and Chapelle (Abstr. 8660/1955), is in accordance with the author's theory of intrinsic block structure (Abstr. 1895/1950). G.F.Lothian

535.434

3655. SELECTIVE SCATTERING OF LIGHT BY PIGMENT-CONTAINING PLANT CELLS. P.Latimer and E.Rabinowitch. J. chem. Phys., Vol. 24, No. 2, 480 (Feb., 1956).

Light scattered through 90° by a suspension of green alga chlorella cells shows absorption maxima at wavelengths about 25 mμ shorter than those characteristic of the pigments (chlorophyll and carotenoids). G.F.Lothian

535.436

3656. STUDY OF THE INFLUENCE OF INTERACTIONS ON THE LIGHT SCATTERED BY AN ASSEMBLY OF PARTICLES. H.Benoit and W.H.Stockmayer.
J. Phys. Radium, Vol. 17, No. 1, 21-6 (Jan., 1956). In French.

Development of a theory given earlier (Abstr. 118/1956). An expression is deduced for the anisotropy of a gas or dilute solution which is similar to that for a perfect gas, with an additional term arising from the non-random angular distribution function (g) of the molecules. If g is a function only of the potential energy (E) arising from the relative orientation of 2 molecules in the form $g = \exp.(-E/kT)$, the expression can be developed so that numerical values of the additional factor can be computed; such values are given for vapours of several simple molecules. It is shown that the theory cannot be applied to liquids. G.F.Lothian

535.5

3657. NEW CALCULUS FOR THE TREATMENT OF OPTICAL SYSTEMS. VIII. ELECTROMAGNETIC THEORY. R.C.Jones.
J. Opt. Soc. Amer., Vol. 46, No. 2, 126-31 (Feb., 1956).

Preceding papers (Abstr. 3724/1948) presented a systematic procedure for computing the effect of an optical system on the state of polarization of the light that passes through it. The M-matrices discussed in the first six papers represent the over-all effect of an optical system; the N-matrices described in Pt. VII are essentially path derivatives of the M-matrices and represent the local optical properties at a given point along the light-path. In this paper it is supposed that the medium is an anisotropic crystal and the description of the local optical properties by the N-matrices must be closely related to the description of the local properties by the dielectric and gyration tensors that are employed in standard crystal optics. The exact relation is found between the N-matrix and the above-mentioned tensors. It is shown how one can compute the dielectric and gyration tensors from a knowledge of the N-matrices for several different directions of the light-path in the crystal. It is also shown how one can compute the N-matrix for any given light direction from a knowledge of the dielectric and gyration tensors; the computation entails finding the square root of a two-by-two complex matrix. Taken together, the eight papers of this series present a compact and systematic procedure for the solution of problems in crystal optics. The N-matrices have the advantage that circular birefringence and circular dichroism are treated in the same framework used for linear birefringence and linear dichroism. A.

535.557 : 541.64

3658. A THEORY OF THE MAXWELL EFFECT OF SOLUTIONS OF CHAIN MACROMOLECULES. II. R.Cerf.
C.R. Acad. Sci. (Paris), Vol. 241, No. 21, 1458-60 (Nov. 21, 1955). In French.

A formula which is said to follow from the theory given in a previous paper (Abstr. 949/1956) is stated for solvents of low viscosity. Calculations for other cases are in progress. Advantage over earlier theories is that both the magnitude of birefringence and the angle of extinction are explained. G.F.Lothian

535.65

3659. GLASS COLOR STANDARDS FOR MAPLE SIRUP. B.A.Brice and A.Turner, Jr.
J. Opt. Soc. Amer., Vol. 46, No. 4, 293-9 (April, 1956).

Previous official colour standards for maple syrup, designated Light Amber, Medium Amber, and Dark Amber, were solutions of sugar caramel in glycerin standardized in terms of transmittance at 560 mμ. These solutions were not satisfactory because of instability of colour and inconvenience of repeated preparation. Glass colour standards were accordingly developed to match the chromaticities of fresh standard solutions in 31.5 mm depth. An improved colour comparator was devised for use with the glass standards. The caramel-glycerin solutions and maple syrup were characterized spectrophotometrically and in terms of several one-dimensional colour scales in use in the sugar industry. Complete specifications for the standard solutions and new glass standards are presented in the CIE system. Colour tolerances were established in MacAdam units of chromaticity difference and a simple one-wavelength method of testing glasses for the production of duplicate standards was developed. A.

535.65

3660. INTERIM REPORT TO THE COMMISSION INTERNATIONALE DE L'ÉCLAIRAGE, ZURICH, 1955, ON THE NATIONAL PHYSICAL LABORATORY'S INVESTIGATION OF COLOUR MATCHING (1955). W.S.Stiles. Appendix: Mean result for pilot group of ten subjects. W.S.Stiles and J.M.Burch.
Optica Acta, Vol. 2, No. 4, 168-81 (1955).

For various reasons, detailed in the paper, a fresh determination of colour-matching data for the average observer is required and this is being made at the N.P.L. The special trichromator constructed for the purpose enables matches to be made with field sizes of 2° and 10°, and the results obtained with a pilot group of 10 subjects are given in an appendix by the author and J.M.Burch. There is a considerable spread, especially in the extreme violet. The results so far obtained are compared with the existing (Commission Internationale de l'Eclairage, 1931) data and with Judd's modified data (Commission Internationale de l'Éclairage, 12th Session, Vol. I, 7.11, 1951). The results of a re-determination by 28 subjects of the relative luminous efficiency function V_λ are also given. J.W.T.Walsh

535.653.85

3661. EXTENSION OF THE MUNSELL RENOTATION SYSTEM TO VERY DARK COLORS. D.B.Judd and G.Wyszecki.
J. Opt. Soc. Amer., Vol. 46, No. 4, 281-4 (April, 1956).

By using the same principles by which the OSA Subcommittee on the Spacing of the Munsell Colours extended the definition of the ideal Munsell system beyond the gamut of the colours actually observed, this definition has been further extended to Munsell renotation values less than 1/. These principles conform to the logical requirement that the constant-chroma locus for any chroma, however small, must extend beyond the spectrum locus (and the straight line connecting its extremes) as Munsell renotation value approaches 0/ if the Munsell renotation chroma is to correlate with the saturation of the colour perception of the specimen viewed against a neutral background of Munsell value greater than 5/. A.

535.683.1

3662. FADING OF COLOURED OBJECTS UNDER THE ACTION OF DAYLIGHT AND THE LIGHT FROM TUNGSTEN FILAMENT AND FLUORESCENT LAMPS. J.J.Balder.
Lichttechnik, Vol. 8, No. 2, 57-61 (Feb., 1956). In German.

Eighty test objects of different kinds, including oil colours water colours and textiles were given exposures of 8 million lux hours under 4 illuminants, daylight transmitted through window glass, tungsten lamp light and the light from two kinds of fluorescent lamps, "warm white de luxe" and "white de luxe". The degree of fading was judged by eye on a scale of 0 to 5, ranging from "no fading" to "very severe fading". The results are shown graphically and it appears that in general daylight is most effective in causing fading, followed in turn by white de luxe, tungsten and warm white de luxe. J.W.T.Walsh

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.81

3663. TESTS ON SOME SUBSTANCES CAPABLE OF USE AS OPTICAL CEMENTS. Y.Besse and J.Demarcq.
Rev. Opt., Vol. 35, No. 1, 21-34 (Jan., 1956). In French.

Eight synthetic resins have been tested to determine their value as optical cements. None possess all the desirable properties of a cement although a few possess sufficient advantages to be of practical value. Tables of properties are given and brief details of the methods of test. R.W.Fish

535.824.2

3664. FORMULAE FOR THE CALCULATION OF COPIES OF MICROSCOPE OBJECTIVES. R.Pellieux.
Rev. Opt., Vol. 35, No. 1, 18-20 (Jan., 1956). In French.

In the case of high-aperture microscope objectives, small changes in glass refractive index have a greater effect upon marginal rays than paraxial rays. Formulae are given allowing the change of radius of curvature to be calculated which will bring the marginal rays to their original position. This is said to be sufficient to compensate for the changes in index. R.W.Fish

535.89

3665. DECADE LIGHT ATTENUATOR. J.Jánossy and Z.Náray.
Acta phys. Hungar, Vol. 5, No. 2, 133-42 (1955).

A light attenuator is described which consists of a number of magnifying stages placed in succession. Details of the construction and the results of calibration are given. The attenuator is suitable for the reduction of the incoming intensity by factors of 10, so that output intensities 10^{-n} times input intensity with n = 1, 2, ..., 9 can be obtained. The various attenuation factors can be obtained by placing lenses and diaphragms into fixed positions without changing the positions of either the input or output diaphragm. A.

535.89

3666. SMALL FILAMENT LAMPS WITH LENSES IN TORCHES WITH REFLECTORS. J.Euler.
Optik, Vol. 13, No. 3, 128-40 (1956). In German.

In small electric torches only 60% of the light is focused by the reflector. The use of lamps having moulded lenses on the lamps themselves allows about ⅔rds of the wasted light to be utilized. An account is given of the experimental methods and the results obtained in measuring light distribution in typical systems. The effect of errors in centration is discussed. R.W.Fish

535.89

3667. STUDY OF SOME SOURCES OF INFRARED.
A.M.Vergnoux, J.Lacourt and F.Rouquayrol.
Rev. Opt., Vol. 34, No. 11, 575-8 (Nov., 1955). In French.

Lithium fluoride and fused silica, heated in a gas flame give good emission for $\lambda > 3\ \mu$, with little at shorter wavelengths. G.F.Lothian

HEAT 536

536.2 : 538.566 : 535.42

APPLICATIONS OF THE FOURIER INTEGRAL IN PHYSICAL SCIENCE. See Abstr. 2814

536.2.01 : 537.311.33

3668. THE THERMAL CONDUCTIVITY OF BISMUTH TELLURIDE. H.J.Goldsmid.
Proc. Phys. Soc. B, Vol. 69, Pt 2, 203-9 (Feb., 1956).

Measurements were made in the range of temperature 150° K to 300° K. It was found that the electronic contribution to the conduction of heat is considerably greater for specimens in which the charge carriers are intrinsically excited than for specimens in which most of the carriers arise from an impurity concentration; this can be explained by the theory which takes into account the transfer of ionization energy down a temperature gradient (see Abstr. 3727/1955). A.

536.21 : 681.142

3669. THE SOLUTION OF NON-LINEAR HEAT-CONDUCTION PROBLEMS ON THE PILOT ACE. E.L.Albasiny.
Proc. Instn Elect. Engrs, Paper No. 2033 M, publ. March, 1956, 5 pp. To be republished in Vol. 103 B (1956).

A method, suitable for use on an automatic computer, is developed for the solution of the heat-conduction equation. The treatment of latent heat is discussed and the method applied to a simple case. An Ace programme is briefly described, and the results obtained for a typical experimental case are given in graphical form. A.

536.212.2 : 537.311.31

3670. THE THERMAL AND ELECTRICAL CONDUCTIVITY OF SILVER-PALLADIUM AND SILVER-CADMIUM ALLOYS AT LOW TEMPERATURES. W.R.G.Kemp, P.G.Klemens, A.K.Sreedhar and G.K.White.
Proc. Roy. Soc. A, Vol. 233, 480-93 (Jan. 10, 1956).

Measurements have been made from 2 to 300° K of the thermal and electrical conductivities of a wide range of silver-palladium and silver-cadmium alloys. The thermal conductivity is resolved into its electronic and lattice components. It is shown that in annealed alloys below 10° K the lattice waves are scattered mainly by free electrons, that the conduction electrons interact with waves of all polarizations, and that this scattering is particularly strong for alloys of high palladium content, where one expects holes in the d-band. Above 40% palladium, s-d scattering increases the electrical resistance and serious departures from Matthiessen's rule are observed. The lattice conductivity of strained specimens is much lower, and the additional thermal resistance varies as T^{-2}, as does the resistance due to interactions with conduction electrons. It is suggested that the additional scattering is due to dislocations of large Burgers vector. A.

536.212.3

3671. THE AXIAL-FLOW ERROR IN THE THERMAL-CONDUCTIVITY PROBE. J.H.Blackwell.
Canad. J. Phys., Vol. 34, No. 4, 412-17 (April, 1956).

In connection with the development of the thermal-conductivity probe (Abstr. 4449/1954) the author has used a new boundary condition of Jaeger to find an expression for an upper limit to the axial-flow error in these devices. Unlike in previous attempts at this problem the short-circuiting effect of the probe material is taken into account. A.

536.23

3672. THE THERMAL CONDUCTIVITY OF ARGON BETWEEN 0° C AND 75° C AT PRESSURES UP TO 2500 ATMOSPHERES. A.Michels, A.Botzen, A.S.Friedman and J.V.Sengers.
Physica, Vol. 22, No. 2, 121-8 (Feb., 1956).

The thermal conductivity was measured by the parallel plate-method. The results are compared with the values calculated from Enskog's formulae for dense gases. A.

536.24

3673. SOME NUMERICAL EVALUATIONS OF HEAT FLOW IN THE REGION BOUNDED INTERNALLY BY A CIRCULAR CYLINDER. H.Goldenberg.
Proc. Phys. Soc. B, Vol. 69, Pt 2, 256-60 (Feb., 1956).

The cylinder surface is assumed to be maintained at constant temperature while the region outside the cylinder is initially at zero temperature. Expressions are derived and graphical results presented in non-dimensional form for the

transient temperatures at individual points outside the cylinder and for the total flux of heat crossing unit area of the surface, up to any time. S.Weintroub

536.241

3674. SOME EXPERIMENTS ON THERMAL CONTACT AT LOW TEMPERATURES. R.Berman.
J. appl. Phys., Vol. 27, No. 4, 318-24 (April, 1956).

An apparatus for studying heat contact at low temperatures is described. Measurements of heat transfer between various surfaces in vacuo have been made. The thermal conductance is independent of the area of the surfaces and is nearly proportional to the force between them, up to forces of about 200 lb. At helium temperatures the conductance between all the types of surfaces examined is proportional to T^3, but the temperature dependence is small at nitrogen temperatures. For metal contacts the electrical conductance is extremely sensitive to the previous history of the surfaces, but the heat conductance is little dependent on this. The thermal conductance is always much greater than corresponds to the electrical conductance according to the Wiedmann–Franz–Lorenz law and this fact, together with the differing behaviour of the two conductances under changing loads, suggests that nearly all the heat flow takes place through electrically non-conducting parts of the surface. The main results are collected together in a table. A.

536.25 : 532.517.4

3675. THERMAL CONVECTION IN A CIRCULAR TUBE DURING TURBULENT FLOW. G.Ribaud.
C.R. Acad. Sci. (Paris), Vol. 242, No. 8, 959-64 (Feb. 20, 1956). In French.

It is shown that for large values of Prandtl's number the idea of a purely laminar boundary layer yields convection coefficients which are somewhat too low. Much better agreement with experiment is obtained by using a formula proposed earlier by the author. R.O.Davies

536.413 : 539.219

3676. ON THE THERMAL EXPANSION AS A FUNCTION OF THE DEGREE OF ORDER OF ATOMS IN BINARY ALLOYS. V.Hovi.
Ann. Univ. Turku. A, Vol. 18, No. 1, 12 pp. (1955).

On the basis of a formula obtained for the free energy of a binary alloy by means of Kirkwood's series expansion method an equation has been derived for the thermal expansion coefficient as a function of the long-range order parameter s and its first and second derivatives with respect to T and V. With certain assumptions concerning the finitude of these derivatives when $s \to 0$, it was possible to verify with the aid of the formula the discontinuity in thermal expansion for β-brass at the Curie point. Reference is made to the dilatometric data reported for this alloy by Steinwehr and Schulze. A.

536.423 : 533.7

3677. STATISTICAL THEORY OF PHASE TRANSITION. III. APPLICATION TO VAPOR–LIQUID–SOLID EQUILIBRIUM. I.Shimose.
J. Phys. Soc. Japan, Vol. 11, No. 3, 202-5 (March, 1956).

For Pt II see Abstr. 10131 (1954). Generalizing the idea of molecular clusters introduced in Pt I for a lattice gas with no sublattice, the equation of state was calculated for a lattice gas with many interstitial sublattices. Thus it was shown that the stable liquid phase, together with the vapour and solid phases, can exist in the above system. Furthermore, the relation between the two phase transitions, that is the vapour–liquid and the liquid–solid transitions, is clarified from the point of view of molecular clusters. A.

536.423.15

3678. VAPOR PRESSURES OF THE METHANES. G.T.Armstrong, F.G.Brickwedde and R.B.Scott.
J. Res. Nat. Bur. Stand., Vol. 55, No. 1, 39-52 (July, 1955).

Experimental measurements of the vapour pressure of CH_4 and the differences in vapour pressures of CH_4 and the deuteromethanes below the normal boiling point are presented. A critical review of the literature relating to the vapour pressures of methane and the deuteromethanes is given. On the basis of the experimental measurements and the previous literature the following best values are assigned to fixed points on the vapour pressure curves. The triple points are: CH_4, 87.50 mm, 90.66°; CH_3D, 84.5 mm, 90.41°; CH_2D_2, 82.0 mm, 90.17°; CHD_3, 80.2 mm, 89.96°; CD_4, 79.1 mm, 89.79° K. The boiling point of CH_4 is 111.67° K; the critical point 45.6 atm and 190.6° K. Equations and a table are given for the vapour pressure of CH_4 in the solid region, the liquid region below the normal boiling point and the liquid region above the normal boiling point. The ratios of the vapour pressures of the methanes are expressed by equations of the form $T \log_{10} P_D/P_H = A - B/T$. The constants A and B have the values, respectively: in the solid range CH_3D, 1.260, 110.2; CH_2D_2, 2.694, 222.2; CHD_3, 4.452, 351.7; CD_4, 5.529, 410.5; in the liquid range, CH_3D, 1.328, 129.5; CH_2D_2, 2.671, 245.4; CHD_3, 3.969, 343.8; CD_4, 5.159, 421.1. The vapour-pressure ratios of the isotopic methanes form a nearly geometric progression with increasing deuterium substitution. Deviations of their mixtures from ideal solutions are very small. A.

536.45

3679. BEHAVIOUR OF MATTER AT EXTREMELY HIGH TEMPERATURES. W.Finkelnburg.
Chem.-Ingen.-Tech., Vol. 27, No. 3, 121-3 (March, 1955). In German.

Discusses the production in laboratory of temperatures up to 50 000° K in high-intensity electric arcs and the possibility of measuring these temperatures by spectroscopic methods. The present state of knowledge of the electric and thermal behaviour of matter at these high temperatures is also discussed. 12 references. F.Lachman

536.48

3680. THERMOMOLECULAR PRESSURE RATIOS FOR He^3 AND He^4. T.R.Roberts and S.G.Sydoriak.
Phys. Rev., Vol. 102, No. 2, 304-8 (April 15, 1956).

Thermomolecular pressure ratios of He^3 have been measured for a tube extending from room temperature to a bulb at 2° K. The results agree within experimental accuracy with He^4 ratios calculated from the Weber–Schmidt equation. Detailed calculations from this equation are given. Limitations of the equation due to large deviations from ideal viscosity behaviour in the liquid helium range are discussed. A.

536.48 : 536.631

3681. THE LOW TEMPERATURE HEAT CAPACITIES OF TWO DIAMAGNETIC ALUMS. D.G.Kapadnis and R.Hartmans.
Physica, Vol. 22, No. 3, 173-80 (March, 1956).

A calorimetric determination of the specific heats of polycrystalline potassium aluminium alum and ammonium aluminium alum has been made in the temp. regions from 1.1 to 4.2° K and 14 to 20° K. The experimental results in the liquid helium temperature range can be represented by $c_p = 3.35 \times 10^{-3}\ T^3$ J/mole-deg and $c_p = 3.18 \times 10^{-3}\ T^3$ J/mole-deg respectively for the two alums. The Debye characteristic temperature computed for KAl alum is 83.4° K and that for NH_4Al alum is 84.9° K. The observed deviations from the Debye formula of the heat capacities of a series of alums are discussed. A.

536.48 : 538.222

3682. A NEW METHOD OF CORRELATING THE MAGNETIC TEMPERATURE SCALES OF PARAMAGNETIC SALTS BELOW 1° K. A.H.Cooke, H.Meyer and W.P.Wolf.
Proc. Roy. Soc. A, Vol. 233, 536-55 (Jan. 10, 1956).

By making use of the extremely anistropic susceptibility of cerium magnesium nitrate to provide a magnetic thermometer the susceptibilities of several paramagnetic salts have been determined at temperatures below 1° K. The measurements

have been made on specimens in the form of a spherical shell of the substance to be examined enclosing a single crystal sphere of cerium magnesium nitrate. By measurements on the compound specimen in directions parallel and perpendicular to the magnetic axis of the cerium crystal, the susceptibilities of the two components can be separately determined. Since that of the cerium salt obeys Curie's law accurately, the temperature is readily found, and hence the susceptibility-temperature relation for the material of the shell. The problem of thermal contact between the components has been investigated, and it is shown that reliable results can be obtained at temperatures down to 0.05°K. The demagnetizing effects in a concentric spherical specimen have been calculated, and all the results are expressed in terms of the magnetic temperature T^*, defined from the inverse of the susceptibility of a specimen in the form of a solid sphere. Measurements have been made on neodymium magnesium nitrate, three cupric Tutton salts, ferric ammonium alum, and manganous ammonium sulphate. The results obtained with neodymium magnesium nitrate are compared with the behaviour predicted theoretically, and good agreement is found. A.

536.48 : 538.247

3683. THE TEMPERATURE REGION WHERE SPINS "REIGN". N.Kurti.
J. Phys. Radium, Vol. 17, No. 2, 85-94 (Feb., 1956). In French.

Text of a lecture preceding presentation of the Holweck prize to the author. The principles of magnetic cooling and its applications to the study of paramagnetism and nuclear orientation are reviewed. D.Shoenberg

536.48

3684. KINEMATIC VISCOSITY OF HELIUM II.
R.J.Donnelly, G.V.Chester, R.H.Walmsley and C.T.Lane.
Phys. Rev., Vol. 102, No. 1, 3-4 (April 1, 1956).

By observing the time of formation of the meniscus in a cylindrical vessel suddenly given a rotation, it has been found possible to determine, directly, the kinematic viscosity of both He I and He II. At the angular velocities used (~ 15 rev/sec) it appears that, for He II, all the liquid rotates rather than the normal component alone. A.

536.48 : 534.21

3685. ULTRASONIC PROPAGATION IN LIQUID HELIUM.
C.E.Chase.
Amer. J. Phys., Vol.24, No.3, 136-55 (March, 1956).

A series of measurements of the propagation of sound in liquid helium are described, and the result discussed in terms of various aspects of the theory of liquid helium. Measurements of the velocity were first made at 14.2 Mc/s over the temperature range from the normal boiling point down to 1.2°K, with particular attention to the low-temperature region and the neighbourhood of the λ point. The attenuation was later measured at 2.0, 6.0 and 12.1 Mc/s, and the measurements were extended down to 0.85°K. A few velocity measurements were also made at these frequencies. Finally the 12.1 Mc/s results were extended down to 0.1°K by the technique of adiabatic demagnetization. The attenuation in helium II is anomalously high and passes through two closely spaced maxima a little below 1°K, finally falling smoothly toward zero at the absolute zero. No adequate theoretical explanation for this behaviour exists, although above 1°K the high attenuation has been explained qualitatively. Near the λ point the attenuation rises to another very sharp maximum and the velocity passes through a minimum. This behaviour sheds some light on the nature of the λ transition. The first part of this paper is devoted to a brief review of relevant experimental and theoretical aspects of the liquid helium problem. A.

536.48

3686. PROBLEMS OF FILM FORMATION AND FLOW IN LIQUID HELIUM II. S.Franchetti.
Nuovo Cimento (Ser. 10), Vol. 2, No. 5, 1127-9 (Nov., 1955).

As an approach to the theory of liquid helium the author suggests the assumption of single helium atoms moving in a periodic field of force. A number of relations are listed which, as the author asserts, are consequences of the above approach. No deductions are given. R.Eisenschitz

536.48

3687. DETERMINATION OF THE VELOCITY OF ULTRASONIC WAVES IN LIQUID HELIUM BY THE OPTICAL METHOD. G.J.Van Den Berg, A.Van Itterbeek, G.M.V.Van Aardenne and J.H.J.Herfkens.
Physica, Vol. 21, No. 11, 860-6 (Nov., 1955).

The velocity of sound in liquid helium was measured by means of the optical method (Abstr. 8107/1954) at temperatures between 1.2 and 4.2°K. The results are compared with the data obtained by other methods. It was not possible to approach the λ-point in such a way that the decrease in velocity at this temperature was larger than according to previous results by other methods. A.

536.483

3688. AN IMPROVED HELIUM LIQUEFIER AND CRYOSTAT.
D.F.Brewer and D.O.Edwards.
J. sci. Instrum., Vol. 33, No. 4, 148-50 (April, 1956).

A Linde helium liquefier-cryostat suitable for visual observations is described. It is similar to the Daunt and Mendelssohn type, but has greatly improved characteristics. Modifications have been made in the method of pre-cooling the circulating gas to 90°K and in the heat interchangers. A separate 14°K stage has also been incorporated. About 750 cm^3 of liquid are produced at the rate of one litre per hour. A.

536.483 : 539.89

3689. ALIGNMENT OF HYDROGEN MOLECULES BY HIGH PRESSURE. F.London.
Phys. Rev., Vol. 102, No. 1, 168-71 (April 1, 1956).

Hydrogen molecules may be oriented by compressing solid hydrogen. If such orientation should prove practicable it would provide a mechanism producing very low temperatures by adiabatic compression of solid HD. The pressures necessary are estimated to be of the order of 10 000 atmos. A.

536.5.081

3690. NEW DETERMINATION OF THE TEMPERATURE OF GOLD AND SILVER POINTS ON THE THERMODYNAMIC TEMPERATURE SCALE. J.Oishi, M.Awano and T.Mochizuki.
J. Phys. Soc. Japan, Vol. 11, No. 3, 311-21 (March, 1956).

The freezing points of gold and silver are determined by a constant-volume nitrogen gas thermometer with a gas bulb made of silica glass. The temperature of the gold point which is adopted as 1063.0°C on the international temperature scale is determined as $T_{Au} = 1336.84 \pm 0.05$ on the Kelvin scale and $t_{Au} = 1063.69 \pm 0.05$ on the Celsius scale. The temperature of the silver point which is 960.8°C on the international temperature scale is $T_{Ag} = 1234.43 \pm 0.05$ and $t_{Ag} = 961.28 \pm 0.05$ on the Kelvin and Celsius scales respectively. A.

536.521

3691. CINEMATOGRAPHIC OPTICAL PYROMETRY FOR COMPARISON OF BRIGHTNESS. R.Chion.
C.R. Acad. Sci. (Paris), Vol. 242, No. 2, 232-4 (Jan. 9, 1956). In French.

An optical system is described for simultaneous cinematography of the test source and of a filament through a neutral wedge. Brightness temperatures can thus be determined by density matching. Relatively low temperatures can be measured with infrared plates. The method may be used for study of time and spatial variation of temperature in bodies under powerful induction heating and also for flames. A.G.Gaydon

536.587

3692. THERMISTOR TEMPERATURE CONTROL.
P.R.Malmberg and C.G.Matland.
Rev. sci. Instrum., Vol. 27, No. 3, 136-9 (March, 1956).

A temperature controller using small bead thermistors as temperature sensing elements has been developed. The controller has an over-all range of +20 to +300°C, or −60 to +190°C, using 51A2 or 32A12 thermistors, respectively, in an a.c. bridge. Extension of the operating temperature range to other limits is possible using other sensing elements. Linear proportional action is achieved with power relay output by comparing the amplified and rectified bridge signal with a stable and linear sawtooth wave form. This comparison controls the fractional "on" time of the power relay during a periodic "on-off" cycle. The controller offers stable control under all conditions of unbalance, and is stable to 0.1 deg C or better over an eight-day period. A.

536.631

3693. SPECIFIC HEAT AND HEAT OF TRANSFORMATION OF $MgCd_3$. B.M.Rosenbaum and B.Welber.
J. chem. Phys., Vol. 24, No. 2, 485-6 (Feb., 1956).

The results of the measurements (made in an adiabatic calorimeter) of these quantities show that the ordered state subsists for alloys containing 72.14% of Cd and the transformation between the ordered and disordered states is a second-order one. W.Good

536.631

3694. ON THE QUESTION OF SPECIFIC HEAT AND NATURE OF TRANSFORMATION OF $MgCd_3$. K.G.Homiakov, V.A.Holler and V.A.Troshkina.
J. chem. Phys., Vol. 24, No. 2, 486 (Feb., 1956).

By carefully defining the sphere of ordered states of Cd-poor alloys with composition near $MgCd_3$ the apparent disagreement between the authors' results and those of Rosenbaum and Welber (preceding abstract) is explained. W.Good

536.631 : 536.48

3695. THE LOW TEMPERATURE SPECIFIC HEAT AND ENTROPY OF $MnBr_2.4H_2O$. D.G.Kapadnis and R.Hartmans.
Physica, Vol. 22, No. 3, 181-8 (March, 1956).

The specific heat of polycrystalline $MnBr_2.4H_2O$ has been measured from 1 to 4.5°K and from 11 to 20°K. A well defined λ-type specific heat anomaly associated with an antiferromagnetic-paramagnetic transition has been observed, the Néel point being 2.136°K. The behaviour of the specific heat curve indicates the persistence of short-range order above the transition point. The net entropy change associated with the process has been found to be about 14.9 joules $mole^{-1}$ deg^{-1}, one-fifth of it being gained above the Néel point. A.

536.633

3696. THE MOLECULAR HEATS OF GASES FROM THE ASPECTS OF HEAT TRANSFER. I.I.Sherif.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 6-11 (Jan., 1956).

The molecular heats of gases have been determined by a modification of the "hot-wire method". The special features of the method are that only small quantities of the gas are needed, the thermal conductivity and the accommodation coefficient can also be determined all in one single operation. Measurements have been made both at ordinary pressures, when the mean free path of the gas molecules is small compared with the dimensions of the hot-wire system, and at much lower pressures, when the mean free path becomes comparable with the dimensions of the apparatus. The results obtained for the monatomic gases agree very closely with the classical value $\frac{3}{2}R$. Those for the diatomic gases approach the value $\frac{5}{2}R$ at ordinary laboratory temperatures. Values of the accommodation coefficients for each gas have also been calculated from the experimental data. A.

THERMODYNAMICS 536.7/.8

536.7

3697. THERMODYNAMIC PROPERTIES OF XENON AS A FUNCTION OF DENSITY UP TO 520 AMAGAT AND AS A FUNCTION OF PRESSURE UP TO 2800 ATMOSPHERES, AT TEMPERATURES BETWEEN 0°C AND 150°C. A.Michels, T.Wassenaar, G.J.Wolkers and J.Dawson.
Physica, Vol. 22, No. 1, 17-28 (Jan. 1956).

From compressibility isotherms of xenon previously published, values of energy, entropy, enthalpy, free energy, free enthalpy, kinetic energy, specific heats and Joule-Thomson coefficient have been calculated. The data are presented at integral values both of density and of pressure. A.

536.7

3698. THERMODYNAMIC PROPERTIES OF GASEOUS ZIRCONIUM. H.G.Kolsky and P.W.Gilles.
J. chem. Phys., Vol. 24, No. 4, 828-30 (April, 1956).

Tables of the thermodynamic properties of zirconium considered as an ideal monatomic gas were calculated using the Los Alamos Scientific Laboratory IBM 701 Computer for a temperature range 0 to 8000°K. A.

536.7

3699. THERMODYNAMIC PROPERTIES OF THE ALKALI METALS. W.H.Evans, R.Jacobson, T.R.Munson and D.D.Wagman.
J. Res. Nat. Bur. Stand., Vol. 55, No. 2, 83-96 (Aug., 1955).

The available data on the thermodynamic properties of the elements lithium, sodium, potassium, rubidium and caesium have been analysed, and selected values of these properties are presented in tabular form. The tables include values of the the free-energy function, $(F^\circ - H^\circ_0)/T$; heat-content function, $(H^\circ - H^\circ_0)/T$; entropy, S°, heat content, $(H^\circ - H^\circ_0)$; heat capacity, C°_p; heat of formation, ΔHf°; free energy of formation, ΔFf°; and logarithm of the equilibrium constant of formation, log Kf, for the solid, the liquid, and the monatomic and diatomic gases as a function of temperature from 0°K to high temperatures. A.

536.7

3700. THERMODYNAMIC AND HYDRODYNAMIC PROPERTIES OF A FLUID IN EQUILIBRIUM IN AN EXTERNAL FIELD THEORY OF CONDENSATION. D.Massignon.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 457-60 (Jan. 23, 1956). In French.

The statistical distribution functions for such a fluid are derived and are used to calculate the local thermodynamic pressure, the fluctuations of the local hydrodynamic quantities, and relations of the type of the Einstein–Smoluchowski relation. The formulae are used to study the condensation of a gas in an external field. E.H.Sondheimer

536.7 : 530.162

STATISTICAL MECHANICS OF IRREVERSIBLE CHANGE.
See Abstr. 2699

536.73 : 536.75

3701. EQUIVALENCE BETWEEN THE PRINCIPLES OF RETARDED ACTION AND INCREASING ENTROPY. O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 241, No. 24, 1721-3 (Dec. 14, 1955). In French.

Considerations of simple macroscopic phenomena suggest that the two principles are equivalent in the sense that one implies the other. R.A.Newing

536.75 : 538.222 : 548.7

3702. SUSCEPTIBILITY AND ENTROPY OF F-CENTERS IN ALKALI HALIDES BELOW 1°K. J.Korringa and J.G.Daunt.
Phys. Rev., Vol. 102, No. 1, 92-5 (April 1, 1956).

The entropy and the paramagnetic susceptibility of F-centres in alkali halides below 1°K for alkali nuclei with spin $\frac{3}{2}$ have been computed using the model of Kip et al. in which the predominant perturbation of the electron in the F-centre is the magnetic interaction with the neighbour alkali nuclei. The lower limits of temperature possible by magnetic cooling of such systems are set forth and considerations are given as to the practical possibility of such cooling of F-centre assemblies. A.

ELECTRICITY 537

537.122

3703. ON THE MATHEMATICAL CONNECTION BETWEEN THE FEYNMAN AND THE RZEWUSKI CLASSICAL THEORY OF THE ELECTRON. G.M.Prosperi and C.Tosi.
Nuovo Cimento (Ser. 10), Vol. 2, No. 6, 1342-4 (Dec., 1955). In Italian.

Feynman's theory (1949) is represented as a particular case of Rzewuski's non-local theory (1953). R.A.Newing

ELECTROSTATICS. DIELECTRICS 537.2

537.21 : 538.12

3704. DISCONTINUOUS FUNCTIONS IN ELECTROSTATICS AND MAGNETOSTATICS. E.Durand.
Ann. Fac. Sci. Univ. Toulouse, Vol. 19, 161-74 (1955). In French.

A surface integral involving grad. ($\frac{1}{r}$) is set up, which describes the condition at a point distant r from an element of surface dS. The difference in the integral for two points situated on either side of the surface and on a normal to it, is deduced. The same procedure is carried out for a line integral involving grad. (log r). These results are then used to discuss the electrical conditions arising from distributions of surface charges, surface dipoles and volume charges; and the magnetic conditions from surface currents and volume currents. A.E.Kay

537.226

3705. FIELDS AND STRESSES IN DIELECTRIC MEDIA. G.Power.
Brit. J. appl. Phys., Vol. 7, No. 4, 137-44 (April, 1956).

The Maxwell stresses are considered and are used to obtain, in two dimensions, expressions for the mechanical forces experienced at the boundary of an isotropic dielectric owing to the presence of an electric field. Special dielectric boundary shapes are discussed, and the method of conformal transformation is employed in order to satisfy more easily the boundary conditions that are imposed on the fields. A number of cases are studied in detail, and experimental verification is obtained by use of the electrolytic tank. A.

537.226.2

3706. DIELECTRIC PROPERTIES OF AMINES AND METHYLENE CHLORIDE AT 3.38 cm. G.P.Srivastava.
Curr. Sci., Vol. 24, No. 12, 409 (Dec., 1955).

The dielectric susceptibility is shown to vary linearly with pressure over 10-70 cm Hg and to have the following values at 10 cm Hg pressure and 31°C (in units of 10^{-5}): CH_2Cl_2, 0.86; CH_3NH_2, 0.55; $(CH_3)_2NH$, 0.40; $C_2H_5NH_2$, 0.76; $(C_2H_5)_2NH$, 0.69. F.F.Roberts

537.226.2

3707. DIELECTRIC DISPERSION OF ROCHELLE SALT IN THE MICROWAVE REGION. H.Akao and T.Sasaki.
J. chem. Phys., Vol. 23, No. 12, 2210-14 (Dec., 1955).

The dielectric dispersion of Rochelle salt was measured at 3000-20 000 Mc/s using a new method. In this method ε' and ε'' is obtained by measuring the half-power point and the shift of resonant frequency of a rectangular TE_{01} mode cavity. The results show that the relaxation frequency of Rochelle salt exists in the decimetre wave region. A.

537.226.2

3708. STUDY OF THE DIELECTRIC CONSTANT OF FERROELECTRIC ALKALINE PHOSPHATES AND ARSENATES AT VERY LOW TEMPERATURES. S.Le Montagner, J.Le Bot, M.Hagene, F.Lasbleis and M.Le Page.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 475-8 (Jan. 23, 1956). In French.

Curves are shown (on an arbitrary scale of ordinates) of ϵ' and ϵ'' over the temperature range 4-150°K for KH_2AsO_4, RbH_2AsO_4, KH_2PO_4 and RbH_2PO_4 at a frequency of 100 kc/s, and of CsH_2PO_4 and CsH_2AsO_4 at 100 c/s, 10 kc/s and 100 kc/s. The first group show a sharp peak in ϵ'' at a temperature (60-70°K) which is stated to be practically independent of frequency over 100 kc/s-1 Mc/s. The second group show broad asymmetric maxima which, for the caesium arsenate, are markedly displaced upwards in temperature as frequency is increased. The results are briefly discussed. F.F.Roberts

537.226.2 : 548.736.5

3709. REPLACEMENT OF Ti IN $BaTiO_3$ CERAMIC BY Si AND Ge. K.W.Plessner and R.West.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1150-2 (Dec., 1955).

Samples of $BaTiO_3$, $Ba(Ti_{0.9}Ge_{0.1})O_3$ and $Ba(Ti_{0.9}Si_{0.1})O_3$ were prepared and X-ray powder photographs showed a single tetragonal phase with the same unit cell size in all three cases. The dependence of small-signal permittivity on temperature is similar in all cases, the main peak occurring at nearly the same temperature of 120°C, but the magnitude of the peak (at 50 c/s) takes the decreasing values 7900, 4000 and 2800 respectively. The remanent polarization and coercive field decrease in the same order. F.F.Roberts

537.226.3

3710. INFLUENCE OF LIGHT ON THE HERTZIAN DIPOLE ABSORPTION OF SELENIUM. Y.Meinnel, J.Meinnel and Y.Balcou.
J. Phys. Radium, Vol. 17, No. 1, 78-9 (Jan., 1956). In French.

Photodielectric effects are observed in illuminated layers of selenium powder, the dielectric loss showing a peak at different frequencies of applied field for different temperatures. G.F.J.Garlick

537.226.3

3711. LATTICE DEFECTS AND HERTZIAN DIPOLE ABSORPTION OF CUPROUS OXIDE. J.Meinnel, E.Daniel and Y.Colin.
J. Phys. Radium, Vol. 17, No. 1, 79-80 (Jan., 1956). In French.

The change of dielectric loss with applied field frequency is studied for precipitated Cu_2O (from Fehling's solution) and for Cu_2O obtained by oxidation of copper at high temperatures. G.F.J.Garlick

ELECTRIC CONDUCTION. CURRENTS 537.3

537.3

3712. AUTOCURRENTS AND ELECTROMOTIVE FORCES; INTERCHANGEABILITY OF THESE CONCEPTS. A.Perrier.
Helv. phys. Acta, Vol. 28, No. 5-6, 481-2 (1955).

In French.

Discusses the concept of "autocurrents" previously postulated, which provides an equivalent but fundamentally different way of studying the effects arising from potential and temperature gradients in conductors. C.A.Hogarth

537.311.1

3713. EFFECT OF BROMINE ON THE DARK CONDUCTIVITY OF SILVER BROMIDE. G.W.Luckey and W.West.
J. chem. Phys., Vol. 24, No. 4, 879-82 (April, 1956).

The dark conductivity of silver bromide in a bromine atmosphere increases with increasing bromine pressure. The conductivity increases are proportional to the square root of the halogen pressure in the range between 10 and 200 mm of mercury, at temperatures between 25°C and 200°C. The increases agree with those calculated from the corrosion data of Wagner and Teltow, and they are probably caused by positive holes. The increases are affected by the purity of the crystals, and the rate of equilibrium attainment depends on the structure and purity of the samples. In particular, the presence of small amounts of silver in the crystals prevents attainment of equilibrium until all the silver is removed. The rate of silver removal depends on the positive-hole conductivity. The results are in good agreement with the corrosion mechanism suggested by Wagner. A.

537.311.1 : 536.7

3714. THERMODYNAMICAL THEORY OF GALVANOMAGNETIC AND THERMOMAGNETIC PHENOMENA. R.Fieschi.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 4, 1168-70 (1955).

For earlier work see Abstr. 3892 (1955). A further discussion of the theory of transfer phenomena in anisotropic crystals, with special reference to electrochemical potentials. The present paper reconciles the author's work with that of others (references given). J.D.Craggs

537.311.31

3715. MODULATION OF CONDUCTIVITY BY SURFACE CHARGES IN METALS. G.Bonfiglioli, E.Coen and R.Malvano.
Phys. Rev., Vol. 101, No. 4, 1281-4 (Feb. 15, 1956).

Experiments on conductivity modulation by surface charges in metals are reported. Because of the high density of carriers, it is necessary to work on thin films in order to get measurable effects. The experimental technique used and the results obtained are reported. Metals beonging to widely different groups (Au, Bi, Sb) have been tested, and peculiar features have been found. A tentative interpretation of these results is offered, and the nature of the information that could eventually be gained is pointed out. A.

537.311.33

3716. DIFFUSION EFFECTS IN DRIFT MOBILITY MEASUREMENTS IN SEMICONDUCTORS. J.P.McKelvey.
J. appl. Phys., Vol. 27, No. 4, 341-4 (April, 1956).

Drift mobility measurements in semiconductors using small steady d.c. fields are described. It is necessary in such cases to take diffusion as well as drift into account in calculating the mobility from the transit time, and a calculation is made which considers both effects. If the diffusion corrections are made, one may eliminate the pulsed sweep fields which are customarily used in these experiments. Measurements of transit time v. sweep field show that the diffusion corrections are in agreement with experiment. A.

537.311.33

3717. SEMICONDUCTORS AND NUCLEAR RADIATIONS L.Koch.
Onde élect., Vol. 35, 977-80 (Nov., 1955). In French.

An account of the interaction of various radiations with Ge and Si. Permanent, reversible and temporary effects are distinguished, and the possibility of future applications is discussed. T.H.D.Attewell

537.311.33

3718. FIELD DEPENDENCE OF MAGNETOCONDUCTIVITY J.W.McClure.
Phys. Rev., Vol. 101, No. 6, 1642-6 (March 15, 1956).

A theoretical calculation of the magnetic field dependence of the elements of the conductivity tensor has been performed for a crystal with a general electronic energy band structure. It was assumed that the Boltzmann equation is valid and that energy-dependent relaxation time exists. The results are the same as would be given by a superposition of electron gases, whose cyclotron frequencies are related harmonically. The strengths of the harmonics depend upon the energy band structure; in particular, there are certain relations among the which are required by symmetry. The diagonal elements of the conductivity tensor are found to be monotonically decreasing functions of the magnetic field strength. Extension of the calculation to alternating electric fields reveals harmonics in the cyclotron resonance. A.

537.311.33

3719. ELECTRONIC NOISE IN SEMICONDUCTORS.
K.M.van Vliet and J.Blok.
Physica, Vol. 22, No. 3, 231-42 (March, 1956).

A critical survey of some theories concerning the fluctuations in the number of current carriers in ohmic semiconductors is given and the discrepancies between them are discussed The continuity equation is then used as a basic equation to derive the fluctuations. This equation provides a good understanding of the different processes, which give rise to fluctuations: the diffusion term is responsible for the thermal noise; the generation and recombination terms give rise to true resistance fluctuations; the divergence of the conduction current causes shot noise in a narrower sense. The latter two phenomena are not exclusive as is often thought but additive. Further it is shown that there are no principal difficulties to extend this theory to more stochastic variables. By means of the Fokker–Planck formalism a matrix equation is derived from which the variances and covariances of the stochastic variables are readily calculated if all generation and recombination probabilities are known. The equation appears to be a generalisation of an expression derived by Burgess (1954) and is also applicable for non-thermal equilibrium conditions, e.g. for photoconductors. A.

537.311.33 : 537.312.5 : 538.63

3720. THEORY OF THE PHOTOMAGNETOELECTRIC EFFECT IN SEMICONDUCTORS. W.van Roosbroeck.
Phys. Rev., Vol. 101, No. 6, 1714-25 (March 15, 1956).

Results are obtained for the photomagnetoelectric (PME) effect that are more general and exact than those of earlier theory. Through an ambipolar treatment, the underlying general theory for current carrier transport with magnetic field, which can provide similarly unrestricted results for the Hall, Suhl, and magnetic rectifier effects, is first developed. The PME effect is considered in detail for the infinite slab with strongly absorbed steady radiation on one surface and parallel steady, uniform magnetic field. Small Hall angles and constant surface recombination velocities and lifetime are assumed. Small-signal theory is given as well as nonlinear for arbitrary light intensity. The latter provides methods for determining lifetime that require only negligible dark-surface concentration of added carriers, as well as a method for determining surface recombination velocity; curves for these are given for germanium. Expressed in terms of conductance increase, PME current or voltage does not depend explicitly on light intensity nor on recombination velocity for the illuminated surface. Distance along the slab between equipotential probes on opposite surfaces as obtained from a nul measurement in which Dember and PME potentials cancel determines directly the sum of the magnitudes of the Hall angles, upon which the PME effect depends. A.

537.311.33

3721. MEASUREMENTS OF THE SPONTANEOUS FLUCTUA

TIONS IN CURRENTS WITH VARIOUS CARRIERS IN SEMICONDUCTOR BARRIER LAYERS. W.Guggenbühl and M.J.O.Strutt.
Helv. phys. Acta, Vol. 28, No. 7, 694-704 (1955). In German.

The current fluctuations in p-n junctions have been measured specifically in the white noise region. With junctions in which the current is either caused by the applied voltage or by spontaneous creation of carriers the fluctuations follow the equations of W.Schottky. In junctions in which a practically fluctuation-free current is injected (collector junction of some latest-type p-n-p-alloy transistors), no additional fluctuations are caused by the transition of the junction. Hence it is possible to obtain currents of extremely small fluctuation content, smaller than is usually found in high-vacuum valves. A.

537.311.33

3722. CYCLOTRON RESONANCE IN BISMUTH. M.Tinkham.
Phys. Rev. Vol. 101, No. 2, 902 (Jan. 15, 1956).

It is shown that recent experiments on cyclotron absorption in Bi (Abstr. 1212-14/1956) are not in disagreement with the ellipsoidal band structure proposed by Jones (Proc. Roy. Soc. A., Vol. 147, 396-417 (Nov. 15, 1934) and Shoenberg (Abstr. 5913/1952). F.Ansbacher

537.311.33

3723. RELAXATION EFFECTS IN RECOMBINATION VELOCITY ON GERMANIUM SURFACES UNDER TRANSVERSE ELECTROSTATIC FIELDS. A.Many, Y.Margoninski, E.Harnik and E.Alexander.
Phys. Rev., Vol. 101, No. 4, 1433-4 (Feb. 15, 1956).

The change in the value of s is found to be variable in magnitude and to relax with a time constant which may be as long as several hours for some specimens. C.A.Hogarth

537.311.33

3724. CORRELATION BETWEEN SURFACE RECOMBINATION VELOCITY AND SURFACE CONDUCTIVITY IN GERMANIUM. E.Harnik, A.Many, Y.Margoninski and E.Alexander.
Phys. Rev., Vol. 101, No. 4, 1434-5 (Feb. 15, 1956).

The relaxation effects of surface recombination velocity s are examined with a view to correlating with Stevenson and Keyes' theory of surface recombination and Schrieffer's calculations of surface conductivity. There is a discrepany which can be partly resolved by adjusting the position of the maximum of the curve relating s to ϕ_s where ϕ_s is the potential difference between the Fermi level and the mid-point of the energy gap at the germanium surface. C.A.Hogarth

537.311.33

3725. MODULATION OF THE SURFACE CONDUCTANCE OF GERMANIUM BY PULSED ELECTRIC FIELDS. G.G.E.Low.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1154-7 (Dec., 1955).

The changes in surface conductance are investigated for higher fields than in the previous work. The change from negative to positive potential near the surface is found to arise from the effect of surface traps with long time constants. C.A.Hogarth

537.311.33 : 537.312.5 : 538.639

3726. SATURATION OF THE PHOTOMAGNETOELECTRIC EFFECT IN GERMANIUM AS A FUNCTION OF MAGNETIC FIELD. A.A.Pires de Carvalho.
C.R. Acad. Sci. (Paris), Vol. 242, No. 6, 745-7 (Feb. 6, 1956). In French.

Experimental results support a law of the form $V = CB/[1+(\mu B)^2]$ where V is the e.m.f. produced, B is the magnetic induction, μ the charge carrier mobility and C is a constant. C.A.Hogarth

537.311.33

3727. INTRINSIC HALL EFFECT OF InSb. G.Busch, R. Jaggi and R.Kern.
Helv. phys. Acta, Vol. 28, No. 5-6, 452-3 (1955). In German.

The intrinsic Hall effect is that due to the magnetic field developed by the flow of charge carriers when a current flows in a conductor. The field is of order 1 oersted instead of the usual measuring values of 500 to 10 000 oersteds. The effect (greater at lower temperatures) is observed in InSb, and its field dependence is reported. C.A.Hogarth

537.311.33

3728. PHOTON-RADIATIVE RECOMBINATION IN PbSe, PbTe AND PbS. I.M.Mackintosh.
Proc. Phys. Soc. B, Vol. 69, Pt 1, 115-18 (Jan., 1956).

Estimates are derived for carrier lifetimes in the compounds due to a process of direct electron-hole recombination with emission of a single photon. Existing optical absorption data is used, the recombination rate being calculated from the formula of van Roosbroeck and Shockley (Abstr. 8281/1954). The values given are, for PbSe 0.6 μsec, PbTe 0.8 μsec, and PbS 40 μsec, the errors being estimated at possible factors of 2, 3 and 5 respectively. D.G.Avery

537.311.33

3729. THE ELECTRICAL PROPERTIES OF THE INTERMETALLIC COMPOUNDS Mg_2Si, Mg_2Ge, Mg_2Sn AND Mg_2Pb. U.Winkler.
Helv. phys. Acta, Vol. 28, No. 7, 633-66 (1955). In German.

Detailed description of the preparation, electrical properties, and theoretical interpretation of results for the materials. Measurements of Hall effect, electrical conductivity and thermoelectric power in the range 100 to 1100° K are reported for many samples, including some with deliberately added impurities or stoichiometric defects. The compounds all exhibit intrinsic conduction with energy gaps of $(0.77 - 6 \times 10^{-4}T)$ eV (Mg_2Si); $(0.7 - 8 \times 10^{-4}T)$ eV (Mg_2Ge); and $(0.36 - 3 \times 10^{-4}T)$ eV (Mg_2Sn). Mg_2Pb has partially filled bands and behaves as a highly degenerate semiconductor of low energy gap. C.A.Hogarth

537.311.33 : 538.222 : 538.632

3730. MAGNETIC AND ELECTRICAL PROPERTIES OF MANGANESE TELLURIDE. E.Uchida, H.Kondoh and N.Fukuoka.
J. Phys. Soc. Japan, Vol. 11, No. 1, 27-32 (Jan., 1956).

The temperature dependence of the susceptibility of the antiferromagnetic compound MnTe was measured over a range of temperature between liquid nitrogen temperature and 720° C. An abrupt change in slope and a maximum of the susceptibility curve were found at 37° C and at 55° C respectively. These results are compared with the observed Néel temperatures previously reported by Squire and by Serre. A thermal hysteresis was also found above the Néel temperature, relating to the heat history of the specimen. It is shown that the susceptibility of $MnTe_{1+x}$ (where x, the excess content of tellurium, lies between 0 and 1), is explicable in terms of two phases, MnTe and $MnTe_2$, which possess different susceptibilities. The electrical properties, i.e., the resistivity, the thermo-e.m.f. and the Hall e.m.f., were measured as functions of temperature. Evidence was found of anomalous behaviour at the Néel temperature. A large thermal hysteresis of the resistivity is also found above the Néel temperature, which suggests a change of the crystal structure at about 130° C. A.

537.311.33

3731. RADIATION RESULTING FROM RECOMBINATION OF HOLES AND ELECTRONS IN SILICON. J.R.Haynes and W.C. Westphal.
Phys. Rev., Vol. 101, No. 6, 1676-8 (March 15, 1956).

Radiation produced by the recombination of excess electrons and holes in silicon has been examined both at room temperature and at 77° K. The radiation obtained at room temperature is shown to be an intrinsic property of silicon. It is probably due to indirect transitions of electrons from the conduction band minima to the valence band with phonon cooperation. Additional radiation is found at 77° K which is structure-

sensitive. This radiation is shown to be produced by the recombination of excess carriers with unionized donor and acceptor impurities. Differences between the photon energies associated with the maximum photon emission of intrinsic and extrinsic radiation are in semiquantitative accord with accepted values of ionization energies of the donor and acceptor impurities introduced in the crystal-growing process. A.

537.311.33

3732. DRIFT AND CONDUCTIVITY MOBILITY IN SILICON. G.W.Ludwig and R.L.Watters.
Phys. Rev., Vol. 101, No. 6, 1699-1701 (March 15, 1956).

Drift mobility measurements have been made on eleven silicon single crystals ranging in resistivity from 19 to 180 ohm.cm. The drift mobility of electrons (μ_n) in the purest p-type crystals and of holes (μ_p) in the purest n-type crystals can be expressed by the formulae $\mu_n = (2.1 \pm 0.2) \times 10^9 T^{-2.5 \pm 0.1}$ and $\mu_p = (2.3 \pm 0.1) \times 10^9 T^{-2.7 \pm 0.1}$ between 160 and 400° K. At 300° K μ_n and μ_p are 1350 ± 100 and 480 ± 15 cm² (volt.sec)$^{-1}$, respectively. The conductivity of some of these crystals was measured between 78 and 400° K, and provides independent evidence for the temperature dependences of mobility quoted in the foregoing. Below 100° K hole mobility in the n-type crystals decreases markedly, probably at least in part because of short-time trapping of the injected holes. A.

537.311.33

3733. SURFACE STATES ON GERMANIUM. J.Lees and S.Walton.
Proc. Phys. Soc. B, Vol. 68, Pt 12, 1152-3 (Dec., 1955).

Point contacts were used to investigate the rectification characteristics of specimens of germanium from low resistivity p-type through intrinsic to low resistivity n-type. The 40-60 ohm cm p-type specimens show n-type rectification. The results are discussed in terms of Bardeen's (1947) surface state theory. C.A.Hogarth

537.311.33

3734. CAPACITANCE MEASUREMENTS ON ALLOYED INDIUM-GERMANIUM JUNCTION DIODES. D.R.Muss.
J. appl. Phys., Vol. 26, No. 12, 1514-17 (Dec., 1955).

Donor densities in the base material of fused junction diodes, inferred from capacitance data, are used to calculate majority carrier mobilities. The dependence of capacitance on reverse bias at very low biases is found to be given by the sum of two terms, a space charge capacitance and a capacitance due to the flow of holes as given by Shockley's low level p-n junction theory. A.

537.311.33 : 537.312.5

3735. PHOTOVOLTAIC NOISE IN SILICON BROAD AREA p-n JUNCTIONS. U.F.Gianola.
J. appl. Phys., Vol. 27, No. 1, 51-4 (Jan., 1956).

Discusses certain of the noise characteristics of silicon broad-area junctions which have been developed for use for solar energy conversion. Under constant illumination the photovoltaic output of these junctions has been found to show fluctuations which are characteristic of a 1/f noise power spectrum. For varying illumination the magnitude of the photovoltaic noise voltage has been found to vary considerably, and in fact passes through a pronounced maximum. A plausible explanation of this effect is obtained by assuming that fluctuations are produced in the primary photocurrent as a result of traversing the junction. The assumption of a current-dependent noise mechanism is justified by an independent experiment. A.

537.311.33 : 621.314.63

3736. HIGH-TEMPERATURE AREA-TYPE TITANIUM-DIOXIDE RECTIFIERS. H.C.Gorton, T.S.Shilliday and F.K.Eggleston.
Elect. Engng., Vol. 74, No. 10, 904-7 (Oct., 1955).

Improved processing has led to the production of blue TiO_2 rectifiers which can work for extended periods at temperatures above 250° C. C.A.Hogarth

537.311.33 : 621.317.34 : 621.314.63

3737. MEASUREMENT OF NOISE SPECTRA OF A GERMANIUM p-n JUNCTION DIODE. F.J.Hyde.
Proc. Phys. Soc. B, Vol. 69, Pt 2, 231-41 (Feb., 1956).

Measurements were made of the excess noise generated in a fused-alloy type p-n junction diode in the frequency range 0.12 c/s to 2 Mc/s at 29° C with the reverse direct current I as parameter. The observed noise spectral density may be synthesized from three well-defined types of component: (a) an extensive component proportional to f^{-1} directly observed over five decades, and by synthesis assumed to exist over as many as seven decades of frequency; (b) a component proportional to $(1 + \omega^2\tau_1^2)^{-1}$ associated with a single relaxation time τ_1; (c) a uniform component associated with the 'shot' noise of the measured current I, for frequencies less than $1/2\pi\tau_p$ where τ_p is the hole lifetime. τ_1 was found to increase with increasing I while the intensity of the f^{-1} component increased more rapidly than in proportion to I^2. A.

537.312.5

3738. ON THE EMISSION OF PHOTO-ELECTRONS FROM F CENTRES IN NaCl. B.Sujak.
Acta phys. Polon., Vol. 14, No. 3, 263-4 (1955).

Experimental evidence is presented to confirm the conclusions of Taft and Apker (Abstr. 7900/1951) that the photoelectric emission from coloured RbI on irradiation with protons of 1.6 eV energy is due to F'-centre electrons. G.F.J.Garlick

537.312.5

3739. LUMINOUS [G_L] AND RADIANT [G_R] POWER GAINS OF LIGHT-AMPLIFYING DEVICES. E.E.Loebner.
J. Opt. Soc. Amer., Vol. 46, No. 3, 227-8 (March, 1956).

Draws a distinction between G_L and G_R, and reports results of measurements of G_L (and its variation with operating conditions) in an arrangement which ensures that $G_L = G_R$. J.Dutton

537.312.5

3740. PHOTO-INDUCED HALL EFFECT OF V-CENTER IN KI. E.Yamaka and K.Sawamoto.
J. Phys. Soc. Japan, Vol. 11, No. 2, 176-7 (Feb., 1956).

Irradiation in the V_2-centre absorption band of KI at 3000 A produces a photocurrent due to positive holes with carrier mobilities 2 — 6 cm²/V.sec. G.F.J.Garlick

537.312.5

3741. APPARATUS FOR THE STUDY OF SPECTRAL RESPONSE OF PHOTOELECTRIC SURFACE. H.Mitsuhashi and T.Nakayama.
J. Phys. Soc. Japan, Vol. 11, No. 3, 308-11 (March, 1956).

The output from a monochromator is kept constant for a long time. The monochromatic beam emerging from it is split into two beams, one of which is brought to focus on a thermocouple alternately with the other white beams coming from a reference light source of well-stabilized brightness. Difference in intensity between these monochromatic and white beams generates an a.c. signal which drives the optical attenuator in front of the entrance slit of the monochromator until their intensities are brought into balance. The other monochromatic beam falls upon a photoelectric surface, the spectral response of which is recorded automatically. A.

537.312.5

3742. COMPARISON OF SURFACE-EXCITED AND VOLUME EXCITED PHOTOCONDUCTION IN CADMIUM SULFIDE CRYSTALS. R.H.Bube.
Phys. Rev., Vol. 101, No. 6, 1668-76 (March 15, 1956).

Surface-excited photoconduction is compared with volume-excited photoconduction in crystals with a wide range of sensitivities. Measurements are presented as a function of exciting wavelength for (1) spectral response, (2) photocurrent as a function of light intensity, (3) photocurrent decay time, (4) infrared quenching, and (5) thermally stimulated current. The

results supply additional evidence that the free electron lifetime for surface excitation is smaller than the lifetime for volume excitation because of a higher rate of recombination at the surface, associated with the absorption of moist air on the crystal surface. Correlations are found between the distribution of traps, as indicated by thermally stimulated current measurements, and both (1) the low-temperature spectrum for photoconduction-photostimulation published by Lambe for CdS:Ag, and (2) the variation of photocurrent with light intensity.

A.

537.312.5

3743. SPECTRAL DISTRIBUTION OF PHOTOCONDUCTIVITY. H.B.DeVore.
Phys. Rev., Vol. 102, No. 1, 86-91 (April 1, 1956).

A theoretical analysis of the shape of photoconductivity spectral distribution curves is presented, based upon the effects of surface and volume recombination of the charge carriers liberated by the light. Representative curves of photoconductivity v. absorption are computed and compared with experimental observations. As an application of this analysis, experimental data for antimony sulphide are compared with a theoretical curve, and the difference is found to be resolvable into two bands representing nonphotoconductive transitions.

A.

537.312.5

3744. PHOTOCONDUCTION IN GERMANIUM AND SILICON. M.L.Schultz and G.A.Morton.
Proc. Inst. Radio Engrs, Vol. 43, No. 12, 1819-28 (Dec., 1955).

The origins of intrinsic photoconduction in Si and Ge are discussed in terms of their energy band contours, and the effects of impurities from Groups I, II, III, V, VII and VIII of the Periodic Table which produce impurity photoconduction are described. Impurity photoconduction occurs in some Ge and Si samples well into the infrared and suggests their use for detectors for the far infrared. When the detectors are to be used for radiation in the absorption band ($< 1.8\mu$ for Ge; $< 1.1\mu$ for Si) the impedance and the sensitivity of the cells can be increased by using a p-n junction structure.

C.A.Hogarth

537.312.5

3745. PHOTOEFFECTS IN INTERMETALLIC COMPOUNDS. H.P.R.Frederikse and R.F.Blunt.
Proc. Inst. Radio Engrs, Vol. 43, No. 12, 1828-35 (Dec., 1955).

Intermetallic compounds with the zinc blende, calcium fluorite, and rock salt structures as well as some more complex materials are described in general terms. Optical absorption, photoconduction, photovoltaic effects, and photomagnetoelectric effects are discussed in detail for the III-V compounds and for Mg_2Sn, Mg_2Ge, Mg_2Si. C.A.Hogarth

537.312.5 : 537.533.2

3746. PHOTOEMISSION FROM SILVER INTO SODIUM CHLORIDE, THALLIUM CHLORIDE, AND THALLIUM BROMIDE. W.J.Turner.
Phys. Rev., Vol. 101, No. 6, 1653-60 (March 15, 1956).

The photoelectric work function for the transfer of electrons from a metal directly into an insulating crystal has been investigated for Ag on samples of NaCl, TlCl and TlBr. The results obtained do not confirm the existence of this process in the samples studied although the apparatus has a current sensitivity of 1×10^{-17} ampere. Mott and Gurney have suggested that the work function of the metal–insulator contact would be less than the vacuum work function of the metal by an amount equal to the electron affinity of the insulator. Previous experimental evidence supporting this picture of the contact appears less conclusive in the light of the results of this investigation. During the investigation of the thallium halides, photosignals were observed far beyond the intrinsic edge (0.38μ for TlCl and 0.46μ for TlBr at -150^0C). Intrinsic radiation at low temperature appreciably enhanced the long-wavelength photoresponse. The enhanced response could be bleached by heating the sample to room temperature. It was established that the photoresponse was a property of the crystal rather than photoemission from Ag into the crystal.

A.

537.312.5 : 537.56 : 621.383.27 : 621.387

3747. THE GAS-MULTIPLIER: A NEW TYPE OF ELECTRON MULTIPLIER. C.H.Vincent.
Nature (London), Vol. 177, 391-2 (Feb. 25, 1956).

Describes an electron multiplier working on the principle of cascaded Townsend avalanches. The conditions for stability are discussed and data given for an experimental tube, of a preliminary nature. This used air and gave a gain of 3.2 per stage with a peak undistorted output of about 20 μA, from 8 stages. J.D.Craggs(R)

537.312.5 : 621.383.27

3748. ON THE REDUCTION OF THE DARK CURRENT IN PHOTOMULTIPLIERS. Z.Náray.
Acta phys. Hungar., Vol. 5, No. 2, 159-73 (1955).

The author's aim was to develop new methods for the reduction of the dark current pulse rate of multipliers commercially available, thus wholly or partly replacing cooling, which up to now has been generally used. Two different kinds of investigations were carried out. On the one hand, a method was developed to ensure that only electrons coming from the illuminated surface of the photocathode could arrive at the anode of the multiplier. On the other hand it was investigated, to what extent the number of dark current pulses can be reduced by varying the potential of the layer deposited on the outside surface of the glass envelope of the multiplier. The mechanism of the latter process was also investigated. Combining the above two methods, dark current pulse rates can be reduced by about a factor 1000 at room temperature if the cross-section of the light beam to be investigated is 15 mm^2 or less. A.

537.312.62

3749. ON THE INTERMEDIATE STATE OF A CURRENT-CARRYING SUPERCONDUCTOR. L.Rinderer.
Helv. phys. Acta, Vol. 28, No. 5-6, 453-4 (1955). In German.

Previous results (Abstr. 6154/1955) on the resistance of a current-carrying wire in a transverse magnetic field are used to deduce the radius of the intermediate-state region; the values found are slightly greater than those predicted by London's theory. R.G.Chambers

537.312.62

3750. PHENOMENOLOGICAL EQUATIONS FOR SUPERCONDUCTORS. M.R.Schafroth and J.M.Blatt.
Phys. Rev., Vol. 100, No. 4, 1221-2 (Nov. 15, 1955).

The London equations entail an infinite correlation length of the momenta of the superconducting electrons. In previous papers (Abstr. 1868, 1870/1956) the authors have given reasons for the existence of a finite correlation length related to the mean free path. Here a modification of the London equation is given which is compatible with this concept. It gives an adequate explanation for the increase in penetration depth observed by Pippard (Abstr. 4106/1953) when the mean free path is decreased by the addition of impurities. H.London

537.312.62

3751. VERY HIGH FREQUENCY ABSORPTION IN SUPERCONDUCTORS. M.J.Buckingham.
Phys. Rev., Vol. 101, No. 4, 1431-2 (Feb. 15, 1956).

If T_ω is a suitably defined transition temperature at frequency ω, and T_0 the d.c. value, a simple energy-gap argument suggests that $T_0 - T_\omega \propto \omega^2$. The results of Blevins et al. (Abstr. 1253/1956) fulfil this relation. R.G.Chambers

537.312.62 : 538.569.4

3752. MILLIMETER WAVE ABSORPTION IN SUPERCONDUCTING ALUMINUM. M.A.Biondi, M.P.Garfunkel and

A.O.McCoubrey.
Phys. Rev., Vol. 101, No. 4, 1427-9 (Feb. 15, 1956).

The power absorbed in a chemically brightened waveguide was measured calorimetrically at wavelengths from 9.5 mm to 5.3 mm ($h\nu$ from 1.3 kT_c to 2.33 kT_c), between 0.95 and 1.15° K. The effective transition temperature falls with wavelength, from 1.17° K for d.c. to about 1.07° K at 5.3 mm. The losses in the superconducting state do not fall smoothly with temperature, but show irregular peaks. The results are discussed in terms of an energy-gap model. R.G.Chambers

537.323

3753. USE OF THERMOCOUPLES IN A RADIATION FIELD. H.P.Yockey.
Phys. Rev., Vol. 101, No. 4, 1426 (Feb. 15, 1956).

Discussion of experimental work on the effect of radiation damage on the thermoelectric power of metals.
E.H.Sondheimer

537.323

3754. THERMOELECTRIC POWERS IN PALLADIUM-SILVER AND PALLADIUM-RHODIUM ALLOYS. J.C.Taylor and B.R.Coles.
Phys. Rev., Vol. 102, No. 1, 27-30 (April 1, 1956).

These were measured in the temperature range 77° K to 273° K. The absolute thermoelectric power is found to be highly sensitive to the presence of unoccupied d-band states, and a marked variation with composition is also found in alloys with more than 90% of either element. This latter behaviour is ascribed to a departure of the Fermi surface from an accurately spherical form as the s-electron concentration increases above 0.9 per atom in the silver-rich alloys, and to a contribution to conduction from d-band holes in the palladium-rich alloys. The values of thermoelectric power obtained for the pure metals by extrapolation from the results for alloys where these effects are absent agree well with estimates made on the basis of simple theoretical models. Results of measurements on some palladium-rich palladium-rhodium alloys are also presented and discussed briefly. A.

537.323

3755. THE THERMOELECTRIC POWER OF MONOVALENT METALS. H.Jones.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1191-3 (Dec., 1955).

It is pointed out that the thermoelectric power is very sensitive to the precise form of the Fermi surface and it is not necessary to have "hole conduction" conditions to obtain a positive value. C.A.Hogarth

537.323 : 537.311.32 : 548.736.1

3756. THERMOELECTRIC POWER, ELECTRICAL RESISTANCE, AND CRYSTALLINE STRUCTURE OF CARBONS. E.E.Loebner.
Phys. Rev., Vol. 102, No. 1, 46-57 (April 1, 1956).

The thermoelectric power θ and the electric resistance R of soft and hard carbons were investigated as functions of heat-treatment temperature T_{ht} from 1000° C to 3100° C at three ambient temperatures T of 90° K, 305° K and 573° K. The crystalline structure was studied by means of X-ray powder diffraction technique. For a given T, with increase of T_{ht} the thermoelectric power of soft carbons goes through a flat minimum at $T_{ht} \cong 1400°$ C, increases quite fast to a maximum at about 2100° C, and subsequently drops down again and continues to do so up to the highest T_{ht}. The electric resistance is only very slowly decreasing (plateau) up to $T_{ht} \cong 2000°$ C, with a subsequent rapid decrease up to the highest T_{ht} investigated. The positions of the maximum in θ and of the corresponding knee in resistance (end of plateau) shifts to higher heat treatments with decrease of ambient temperature T. The thermoelectric power is proportional to temperature T in the range of heat treatments below the T_{ht} corresponding to the maximum in θ. The observed dependence of θ and of R on T_{ht} and T are in good agreement with Mrozowski's energy band scheme for carbons and graphites. A hard carbon prepared from phenol-benzaldehyde resin shows a two-stage graphitization with $\frac{1}{3}$ of the crystalline mass beginning to graphitize at $T_{ht} \cong 2200°$ C and the remainder only above $T_{ht} = 2800°$ C. Correspondingly the resistance curves show two plateaus ending one at $T_{ht} \cong 2200°$ C and the other at $T_{ht} \cong 2800°$ C. The dependence of θ on T_{ht} is somewhat similar to that found in soft carbons. A.

537.364 : 541.183

3757. EFFECT OF WATER VAPOR ON GERMANIUM SURFACE POTENTIAL. A.R.Hutson.
Phys. Rev., Vol. 102, No. 2, 381-5 (April 15, 1956).

Relative humidity is known to influence the surface potential of germanium. For all but the very driest of ambients, the germanium surface is covered by a film of water. A calculation is presented, based upon the dielectric properties of such a film of water, which yields a term in the energy level of surface ions. It is shown that the dependence of this term upon water film thickness can quantitatively account for Kingston's observations of surface potential as a function of humidity.
A.

ELECTRIC DISCHARGES 537.52

537.521 : 539.132

3758. ABUNDANCE OF FREE ATOMS IN SOLID NITROGEN CONDENSED AT 4.2° K FROM A GAS DISCHARGE. H.P.Broida and O.S.Lutes.
J. chem. Phys., Vol. 24, No. 2, 484-5 (Feb., 1956).

The increases in temperature, as condensates from the discharge and from a similar flow of ordinary N_2 warm up, are compared. Differences are attributed to heat release in recombination of free atoms and lead to a figure of 0.2% of N in the solid condensate. A.G.Gaydon

537.521 : 539.17

INTENSE GAS DISCHARGES FOR THE INITIATION OF THERMONUCLEAR REACTIONS. See Abstr. 3974

537.525

3759. ELECTRICAL BREAKDOWN IN ARGON AT ULTRA-HIGH FREQUENCIES. A.D.MacDonald and J.H.Matthews.
Canad. J. Phys., Vol. 34, No. 4, 395-7 (April, 1956).

Measured values of breakdown electric fields in pure argon gas are presented. Measurements were made in two resonant cavities at a frequency of 2800 Mc/s and for pressures varying from 4×10^{-3} to 200 mm of mercury. The present results are in agreement with those of Krasik, Alpert, and McCoubrey.
A.

537.525

3760. ANALYSIS OF THE PLASMA OF FLUORESCENT LAMPS. J.F.Waymouth and F.Bitter.
J. appl. Phys., Vol. 27, No. 2, 121-31 (Feb., 1956).

An attempt has been made to explain the properties of the "plasma" of fluorescent lamps in considerable detail, using the ambipolar diffusion theory of Schottky, modified to include ionization by multiple electron impacts. Ionization is assumed to occur by electron collisions with excited and metastable atoms. The cross-section for this process is one of two inaccurately known parameters, which are treated as adjustable constants, occurring in the calculations. The other is the effective diffusion constant for quanta of the resonance line, in the presence of a high-temperature electron gas. Qualitative agreement of the foregoing theory with experiment is demonstrated for all the derived quantities as functions of the several parameters of the discharge. The magnitudes of the calculated electron temperature, electric field, total light output, and efficiency are also in sufficiently good agreement with experimental values for the lamps of greatest commercial interest to permit extrapolations to be made with reasonable confidence. Optimum

agreement of theory with experiment for T-12 lamps is obtained using a mean life-time of ultraviolet photons in the discharge 3.6 times that employed by Kenty for diffusion in un-ionized vapour, and with a value 3.3 for the ratio of cross-section for ionization of excited state to that of the ground state. A.

537.525.3 : 537.525.72/.8

3761. INFLUENCE OF LIGHT INTENSITY ON THE CHARACTERISTICS OF NON-SELF-MAINTAINED REGION OF A LOW FREQUENCY ELECTRIC DISCHARGE. B.D.Khosla.
Curr. Sci., Vol. 25, No. 1, 11-12 (Jan., 1956).

Describes experiments on high-voltage a.c. corona discharges in iodine vapour, using electrodes external to the tube. Current–voltage characteristics, for example, at different intensities of external illumination, are given. There is a brief discussion of the results. J.D.Craggs

537.525.5 : 537.525.8

3762. DISTURBANCE BY PROBE IN PLASMA. T.Okuda and K.Yamamoto.
J. Phys. Soc. Japan, Vol. 11, No. 2, 177-8 (Feb., 1956).

Experiments were made on the effect of probe size on plasma characteristics (in argon at $1\text{-}10^{-4}$ mm Hg pressure). Electron temperatures were measured with probes whose diameters varied from 0.2 to 1.5 mm and the results are tabulated. Disturbances, near a thick probe, of the plasma potential distribution were measured with a thin probe. Some probe characteristics are shown. J.D.Craggs

537.525.5 : 537.525.8

3763. THE ROTATION OF PLASMAS IN A MAGNETIC FIELD. H.Pupke and H.G.Thom.
Naturwissenschaften, Vol. 43, No. 2, 32 (1956). In German.

Briefly describes certain effects observed with discharge plasmas, for example in neon (2 mm Hg pressure) excited at h.f. ($\lambda \sim 4$ m) in a glass toroid and acted upon by external magnetic fields. J.D.Craggs

537.525.8

3764. SURFACE DEPENDENCE OF JOSHI EFFECT IN WATER VAPOUR UNDER LOW FREQUENCY ELECTRIC DISCHARGE. B.D.Khosla, H.C.Gaur and N.A.Ramaiah.
Z. Phys., Vol. 144, No. 5, 572-85 (1956).

Detailed investigations on the dependence of the Joshi effect ($\pm\Delta i$) on the nature of the electrode surface were reported. Δi in water vapour could not be detected in vessels of which the free alkali existing on the electrode surface was removed by acid treatment. Photo-suppression of the current ($-\Delta i$) could be initiated by films like KCl, NaCl, NaOH, etc. deposited or produced on glass surface during continued exposure to discharge. $-\Delta i$ was linearly variant with the surface area exposed to light; the slope of the line was altered appreciably by a change in the nature of the electrode surface. detailed studies with films like KCl, Al_2O_3 and H_3PO_4 not only revealed the significance of the polar nature of the films, but also indicated the prominent role of the dissociation–recombination processes ($H_2O \rightleftharpoons H + OH$) occurrent on the electrode surface, in controlling the magnitude and even the sign of the effect Δi. Remarkably enough, when the surface reaction was inhibited, an increase of the current under exposure to light, referred to as $+\Delta i$, was noticed. A.

537.525.92

3765. STATISTICAL STUDY OF ELECTRON AVALANCHES IN GASEOUS DISCHARGE. S.Kojima and K.Kato.
J. Phys. Soc. Japan, Vol. 11, No. 3, 322-6 (March, 1956).

Size distributions of electron avalanches were observed at a potential several % below the breakdown value. The distributions at low-pressure discharge agreed well with Wijsman's formula which was derived from the Townsend theory in the absence of space-charge effect. The distributions at atmospheric pressure, however, are different from this formula in that the pulses had a tendency to become uniform in size. This tendency was accounted for by the space-charge effect. In connection with these measurements the pulses of corona discharges were also measured. A.

X-RAYS 537.531

537.531

3766. K-SERIES FLUORESCENCE YIELDS OF ARGON, COPPER-65 AND INDIUM-113. G.R.Harrison, R.C.Crawford and J.I.Hopkins.
Phys. Rev., Vol. 100, No. 3, 841-4 (Nov. 1, 1955).

K-series fluorescence yield measurements have been made for A, Cu^{65}, and In^{113} with a proportional counter spectrometer and found to be 0.081 ± 0.006, 0.39 ± 0.02 and 0.82 ± 0.02, respectively. The method is discussed and a comparison with theoretical values is noted. A.

537.531 : 535.33

3767. A COMPARATIVE STUDY OF THE SPECTRA OF THE X-RAYS OBTAINED BY ELECTRONIC BOMBARDMENT AND BY FLUORESCENCE. L.Salgueiro and J.Gomes Ferreira.
Portugal. Phys., Vol. 3, No. 3-4, 139-47 (1954). In French.

A curved-crystal spectrometer was used to study the intensities of the L X-rays of Bi and Pb for these two methods of excitation. Within the limits of the experimental errors involved there was no detectable difference in intensity for the two methods of excitation. J.Hughes

537.531 : 535.343

3768. THE L_I AND L_{II} ABSORPTION DISCONTINUITIES OF GOLD IN THE PURE METAL AND IN THE ALLOYS GOLD–PALLADIUM AND GOLD–SILVER. C.Mande.
C.R. Acad. Sci. (Paris), Vol. 242, No. 6, 755-8 (Feb. 6, 1956). In French.

The L_I discontinuity for gold is shown to have a fine structure, L_I and L_I' discontinuities being resolved. The L_{II} discontinuity is similar to the L_{III} discontinuity.

A.E.De Barr

537.531.08

3769. ABSOLUTE YIELD OF THE FERROUS SULPHATE DOSEMETER. SOFT X-RAYS OF 10 AND 8 keV. M.Cottin and M.Lefort.
J. Chim. phys., Vol. 53, No. 3, 267-73 (March, 1956). In French.

The X-radiation was produced in a Holweck or Beaudoin X-ray tube operated at 30 kV with a molybdenum anticathode and at 15 kV with a copper anticathode. Physical dosimetry was done by means of a free-air ionization chamber on top of which the glass irradiation vessel was placed. The saturation curve of the ionization chamber and the absorption curves for air and water have been measured. 5×10^{-3}M $Fe(NH_4)_2SO_4$ in 0.1 N H_2SO_4 was exposed. Taking W = 34 eV, the $GFe^{+++} = 14.15 \pm 0.6$ for 10 keV X-radiation and drops to $GFe^{+++} = 13.4 \pm 0.6$ for 8 keV X-radiation. M.Ebert

CATHODE RAYS. POSITIVE RAYS 537.533/534

537.533.335

3770. ON THE ESTIMATION OF THE LOWER LIMIT OF SPHERICAL ABERRATION OF MAGNETIC ELECTRON LENSES. H.Grümm.
Optik, Vol. 13, No. 2, 92-3 (1956). In German.

The theory of Tretner (Abstr. 10247/1954), which gave a lower limit to the spherical aberration of magnetic lenses, failed to consider one specific type. It was therefore hoped

that this type would yield a lower aberration, but numerical calculations reveal that Tretner's limitations apply to this also. A.E.I.Research Laboratory

537.533.35

3771. THE SPHERICAL ABERRATION OF FIFTH ORDER OF SPHERICALLY CORRECTED ELECTRON MICROSCOPES. W.E.Meyer.
Optik, Vol. 13, No. 2, 86-91 (1956). In German.

The effect of fifth-order spherical aberration in a system incorporating third-order correctors is calculated and found to agree with experiment. Partial correction of the fifth-order terms could be most simply achieved by placing one of the third-order correctors inside the lens under correction, and properly siting the remaining correctors. The theoretical resolving power of a typical lens (10 A without correction) would become 1 A. A.E.I.Research Laboratory

537.533.35

3772. DETECTION OF ELECTRONS IN THE VERY LOW ENERGY RANGE. G.Giroux and C.Geoffrion.
Canad. J. Phys., Vol. 34, No. 2, 153-8 (Feb., 1956).

To detect electrons of very low energy in a 180° homogeneous-field type of β-ray spectrometer, they are accelerated by a potential of up to 10 kV between the exit slit and a Geiger counter having a narrow entrance window covered with a thin Zapon film (77 $\mu g/cm^2$). This arrangement allows electrons of almost zero energy to be detected with a transmission of 50%, and without the rise of the spurious background usual in such systems. D.R.Chick

537.533.74

3773. MULTIPLE SCATTERING OF ELECTRONS AND POSITRONS IN NUCLEAR EMULSIONS. F.F.Heymann and W.F.Williams.
Phil. Mag. (Ser. 8), Vol. 1, 212-20 (Feb., 1956).

Scattering measurements have been made on electrons and positrons in the energy range 1-3 MeV in Ilford G.5 nuclear emulsions. Angles were measured between successive chords of 50 μ long with an ocular protractor. No correction was made for microscope noise. In order to minimize the energy-loss correction, only four 50 μ chords were measured on each track in the energy range 1.5-2.5 MeV. At 1 MeV, because of the difficulty of finding tracks which were not scattered out of the emulsion, 10 chords were used and the energy-loss correction applied. Values of the scattering constants were obtained at each energy for electrons and positrons. The ratio $K_{exp}/K_{moliere}$ was found to deviate from 1 at low energy. It is probably due to the difficulty of following heavily scattered tracks and to the escape of such tracks from the emulsion. The ratio K_-/K_+ at 2.5 MeV is significantly different from 1 at 1.17 ± .04 without cut-off and 1.14 ± .04 with cut-off. This is larger than that predicted by theory and is being further investigated. D.J.Prowse

537.533.74 : 530.145

3774. SCATTERING OF ELECTRONS FROM NUCLEAR CHARGE FLUCTUATIONS. R.R.Lewis, Jr.
Phys. Rev., Vol. 102, No. 2, 544-9 (April 15, 1956).

An attempt is made to discuss the influence of non-potential-scattering effects in the elastic scattering of electrons from nuclei. It is shown that in the second order of perturbation theory, if the major contributions are assumed to come from low-lying nuclear states, the scattering is completely determined by specifying the average charge density of the ground state, and the density of the fluctuations about this charge distribution. Numerical computations are presented for one simplified model of these distributions. A.

537.533.75

3775. COLLECTIVE OSCILLATIONS AND CHARACTERISTIC ELECTRON-ENERGY LOSSES. D.Gabor.
Phil. Mag. (Ser. 8), Vol. 1, 1-18 (Jan., 1956).

Presents a theoretical consideration of the sharply defined energy losses of medium-energy electrons in thin films in terms of the transfer of energy from the electrons to the collective oscillations of the electron gas in metals. Two crucial consequences of the hypothesis are given, namely: (a) the characteristic energy losses should increase very strongly as the energy-spread of the bombarding electron beam is reduced, and (b) the losses should decrease is the geometrical incoherence of the beam is increased. No effect would be noticed in either case were the phenomenon associated with an atomic collision process. J.Thewlis

537.533.79

3776. MOMENTUM TRANSFER CROSS SECTION AND FRACTIONAL ENERGY LOSS IN THE COLLISIONS OF SLOW ELECTRONS WITH NITROGEN MOLECULES. J.M.Anderson and L.Goldstein.
Phys. Rev., Vol. 102, No. 2, 388-9 (April 15, 1956).

The momentum transfer collision cross-sections, q_m, of nitrogen molecules for slow electrons and the mean fractional electron energy loss, λ, in these collisions have been determined by the method of microwave interaction in gaseous discharge plasmas. The mean energy of the electron was varied from 0.04 to 0.46 eV. The cross-section, q_m, was found to be $\sim 17 \times 10^{-16}$ cm² at 0.04 eV. It decreases to $\sim 8 \times 10^{-16}$ cm² at 0.46 eV. The mean fractional energy loss of the electron, λ, in the energy range investigated, was found to be ~ 5.5 in units of 2m/M. These results lend strong support to the theory of rotational excitation of N_2 by slow electrons. A.

537.533.8

3777. EXCITATION OF ELECTRONS IN METALS BY PRIMARY ELECTRONS. E.M.Baroody.
Phys. Rev., Vol. 101, No. 6, 1679-84 (March 15, 1956).

The excitation of conduction electrons represented by Bloch wave functions through Coulomb interaction with a medium-fast primary is discussed. It is brought out that when the excitation energy is much smaller than the primary energy, the probabilities of transitions in which momentum is exchanged with the lattice (umklapp processes) are proportional to the corresponding probabilities for excitation by light (as was shown by Rudberg and Slater), and that the excitation rate varies roughly as the reciprocal of the primary energy. For cubic metals, the number of transitions per unit primary path with excitation energy in a differential range near $\epsilon = h\nu$ proves to be a simple factor multiplied by the photoelectric absorbing power for light of frequency ν. Using this relationship, and accepting Butcher's interpretation of their optical properties, a rather detailed picture is obtained of the umklapp processes which might be of importance for secondary emission from several alkali metals. The contribution of such transitions appears to be small, but not entirely negligible, in comparison with what would be expected from a free-electron gas. Some remarks are made on the possibility that innershell electrons make an important contribution to secondary emission. A.

537.533.8

3778. ENERGY SPECTRUM OF ELECTRONS PRODUCED IN ALUMINUM BY 17.8-MeV BREMSSTRAHLUNG. R.L.Stearns and E.C.Gregg.
Phys. Rev., Vol. 102, No. 1, 1-3 (April 1, 1956).

A 60° magnetic spectrometer is used to obtain a relative measurement of the integrated energy spectrum of secondary electrons produced at depths of one-half inch and four inches in aluminium by 17.8 MeV bremsstrahlung. The experimental spectra were found to agree with theoretical spectra calculated by the method due to Brysk to within the experimental error of 5%. A.

537.533.8

3779. A NOTE ON SOMMERFELD'S BREMSSTRAHLUNG FORMULA. L.C.Biedenharn.
Phys. Rev., Vol. 102, No. 1, 262-3 (April 1, 1956).

Sommerfeld's bremsstrahlung formula is discussed by the method of angular momenta. The complete correspondence in the classical limit to the work of Landau and Lifshitz is shown. A.

537.533.8

3780. BREMSSTRAHLUNG YIELD OF HIGH-ENERGY ELECTRONS IN HYDROGEN. D.Bernstein and W.K.H. Panofsky.
Phys. Rev., Vol. 102, No. 2, 522-7 (April 15, 1956).

The bremsstrahlung yield of 500 and 550 MeV electrons for the production of 235 MeV photons has been measured in liquid hydrogen. The photons are traced via the production of positive photopions in liquid hydrogen. The result demonstrates a cross-section $(2.4 \pm 2.8)\%$ below the calculations of Wheeler and Lamb. The result can be accounted for by (a) the exchange effect between the final electrons, and (b) interference effect among the protons and electrons in molecular hydrogen. A calculation on the latter effect has been carried out using Heitler–London wave functions. A.

537.533.8 : 621.385.15

3781. ON THE MEASUREMENT OF THE AVERAGE TIME DELAY IN SECONDARY EMISSION. M.H.Greenblatt.
RCA Rev., Vol. 16, No. 1, 52-64 (March, 1955).

The method of measurement consists of a comparison between the duration of short bursts of primary electrons and the duration of the consequent bursts of secondary electrons. Short bursts of primary electrons are produced by deflecting an electron beam at a 400 Mc/s rate across a circular aperture. The bursts of secondaries are analysed by synchronously deflecting them across a fluorescent screen, or presentation electrode. Since the instantaneous deflection varies while the burst of secondary electrons is travelling between the deflection plates, the shape of the pulse of secondaries corresponds to a variation in light intensity across the fluorescent screen. Measurements show that the duration of the pulses of secondaries is larger than that of the primaries by an amount which depends on the accelerating voltage. Pulses of secondaries having a width of 1.3×10^{-10} sec have been produced by pulses of primaries having a width of 6×10^{-11} sec. The difference is mainly due to a dispersion in transit times. The dispersion in time delay in secondary emission must, therefore, be smaller than 7×10^{-11} sec. A.

537.534

3782. CASCADE GENERATORS FOR PARTICLE ACCELERATION TO 4 MeV. W.Heilpern.
Helv. phys. Acta, Vol. 28, No. 5-6, 485-91 (1955). In German.

It is pointed out that the output voltage of cascade (Cockroft–Walton) generators is limited by the number of stages. If this number, n, is too high, excessive ripple results. A new modification of the circuit is proposed which has two symmetrical charging columns and one smoothing column. The ripple is reduced by a factor $1/1 + n$. This makes the construction of a 4 MeV generator possible at the expense of doubling the number of rectifiers and increasing the number of condensers by 50% as compared with the conventional circuit.
H.Motz

537.534

3783. DESIGN OF THE POLE FACES FOR CIRCULAR PARTICLE ACCELERATORS WITH THE ELECTROLYTIC TANK. F.Amman and L.Dadda.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 184-7 (Jan., 1956).

A method is presented for the measurement of a quantity approximately proportional to the second derivative of the electric potential in the electrolytic tank. This method is very useful for the measurement of the field index n in the gap of a circular particle accelerator. A.

537.534

3784. SPACE CHARGE AND IONIZATION PHENOMENA IN CONSTANT-GRADIENT PROTON SYNCHROTRONS. P.B.Moon.
Proc. Phys. Soc. A, Vol. 69, Pt 2, 153-6 (Feb., 1956).

The stability of small oscillations of protons circulating in a synchrotron is investigated on the assumption of a uniform space charge in addition to the magnetic field of constant radial gradient. If the space charge is that of the protons themselves, the greatest number that can be held in a uniform beam of cross-section A is $VB_zA/2e$, where V is the velocity of the protons, B_z is the magnetic field on the equilibrium orbit and the units are electrostatic. One third of this number might be held in a bunched beam of 120° azimuthal length, but existing synchrotrons fall far short of this. Consideration is given to the effects of ionization in the residual gas, and to the possibility that the space charge could be neutralized by the continuous injection of electrons. A.

537.534

3785. TERMINAL OBSERVATIONS ON "ANTIPROTONS". J.M.Brabant, B.Cork, N.Horowitz, B.J.Moyer, J.J.Murray, R.Wallace and W.A.Wenzel.
Phys. Rev., Vol. 101, No. 1, 498-501 (Jan. 1, 1956).

Antiprotons were selected by the apparatus of Chamberlain et al. (Abstr. 1298/1956), trigger equipment consisting of a large glass Cherenkov counter in which the radiation from showers produced by antiprotons can be detected. From the number of large pulses, it is deduced that the antiprotons have a large (~ geometrical) cross-section for interaction with the glass. Insertion of a copper absorber gives an indication of an attenuation cross-section of roughly twice geometrical. G.E.Brown

537.534

3786. NUCLEAR EMULSION OBSERVATION OF ANNIHILATION OF AN ANTIPROTON. R.D.Hill, S.D.Johansson and F.T.Gardner.
Phys. Rev., Vol. 101, No. 2, 907-9 (Jan. 15, 1956).

The probable production and annihilation of an antiproton has been observed in an emulsion exposed to the 6.2 BeV proton beam from the Berkeley Bevatron. A proton-initiated star gives rise to a particle which by blob-density measurements may be a proton of 750 ± 150 MeV, a K-particle of 400 MeV or a π-meson of 110 MeV. The particle causes a star in which the total visible energy is 1410 MeV; this could only result if the particle were an antiproton of 750 MeV. Allowing for the probable energy carried away by neutrons, the energy unaccounted for is then 650 MeV. This could be absorbed by the production of one or two π^0-mesons. Two other possible explanations exist: (1) that the particle is a deuteron of 1500 MeV, or (2) that it is a 2 BeV π-meson giving an anomalously high ionization signal. The first is considered very unlikely but the second has about the same probability as the antiproton explanation. D.J.Prowse

537.534

3787. ANTIPROTON STAR OBSERVED IN EMULSION. O.Chamberlain, W.W.Chupp, G.Goldhaber, E.Segrè, C.Wiegand, E.Amaldi, G.Baroni, C.Castagnoli, C.Franzinetti and A.Manfredini.
Phys. Rev., Vol. 101, No. 2, 909-10 (Jan. 15, 1956).

The star has been observed in an emulsion stack exposed to the magnetically separated beam of negative particles from the Berkeley Bevatron. Intensive scanning has produced this one star; it is initiated by a particle which appears to come to rest, it must therefore be a capture or an annihilation star. The total visible energy is 826 MeV. The ratio M/M_P for the particle obtained from a knowledge of its momentum from magnetic analysis and its range in a copper absorber and in the emulsion, is 1.02 ± 0.04. The event is corroborating evidence that the new particles observed at the Bevatron by Chamberlain (Abstr. 1298/1956) are in fact antiprotons.
D.J.Prowse

537.534.3

3788. A MAGNETIC SPECTROMETER. D.J.Prowse and W.M.Gibson.
J. sci. Instrum., Vol. 33, No. 4, 129-32 (April, 1956).

A little-known type of magnetic spectrometer, for measuring the energy of heavy charged particles, is described. The source is outside the region of magnetic field, which particles enter and leave across a straight boundary; particles of different energies are brought to second-order foci at points along a line which also lies outside the region of maignetic field. The principles and the factors limiting the resolution are discussed briefly. The design and performance of an instrument built for protons of energy up to 8 MeV are described; a resolution up to 1 in 800 in momentum has been obtained. A.

537.534.3

3789. A MAGNETIC ANALYSER FOR HIGH ENERGY PARTICLES. A.Lovati and H.Tyrén.
J. sci. Instrum., Vol. 33, No. 4, 151-4 (April, 1956).

A magnetic analyser for accurate measurement of momentum of nuclear reaction products, employing two-directional focusing with a sector-shaped uniform magnetic field, is described. The instrument is useful for analysing particles with magnetic rigidity up to 2×10^8 G.cm (corresponding to 180 MeV protons and α-particles, 90 MeV deuterons, etc.). A.

537.534.3

3790. FOCUSING PROPERTIES OF A LARGE MASS SPECTROGRAPH NEWLY CONSTRUCTED AT OSAKA UNIVERSITY. H.Matsuda.
J. Phys. Soc. Japan, Vol. 11, No. 3, 183-91 (March, 1956).

A large double-focusing type mass spectrograph constructed in order to increase the accuracy of atomic mass measurement by about one order of magnitude. In this apparatus are adopted $\sqrt{2}(\pi/3)$ cylindrical electric field and $\pi/3$ uniform magnetic field. The focusing properties of this apparatus are discussed from both theoretical and experimental aspects. The direction and velocity focal planes are calculated, and their deviations due to various conditions such as the change of the position of source, the fringing field effect, the deviation of the geometry, etc. are discussed. These results are compared with the experimental procedure of the focal adjustment. A maximum resolving power of 500 000 was obtained experimentally at the present condition, and the mass dispersion is about 9 cm for 1% mass difference in this case. A.

537.534.3 : 539.155.1

EXPLANATION OF DISCREPANCIES IN THE MASS-SPECTROGRAPHIC DOUBLET MEASUREMENTS. See Abstr. 3125

537.534.74

3791. THE POLARIZATION OF 5.3 MeV PROTONS ELASTICALLY SCATTERED FROM HELIUM. A.C.Juveland and W.Jentschke.
Z. Phys., Vol. 144, No. 5, 521-8 (1956).

This was measured by a double scattering experiment with a polarizer-analyser arrangement. The first scattering was selected to take place in the region of the $P_{1/2}$ energy state of Li^8 and of the second scattering at the $P_{3/2}$ state. The polarization after the first scattering at an angle of 55° (c.m.) has been measured to be $P_1 = 0.40 \pm 0.05$ and is positive in agreement with the calculated polarization using the phase shift values obtained from the analysis of differential scattering cross-section data (the positive direction is defined by the vector product between the scattered proton wave vector and the incident proton wave vector). A preliminary experiment with poor geometry and an average scattering angle of 90°(c.m.) also gave results which agree with the calculations. The large splitting of the $P_{1/2}$ and $P_{3/2}$ states and the very broad width of the $P_{1/2}$ level are therefore confirmed. A.

DISCHARGE TUBES. COUNTERS 537.54

537.542

3792. A PROPORTIONAL COUNTER WITH GRID CONTROL. R.J.Norman.
Austral. J. Phys., Vol. 8, No. 3, 419-24 (Sept., 1955).

Describes how the use of a cylindrical grid of wires near the anode of a proportional counter reduces end effects. Data are given for an argon–methane filling and an ethyl formate–argon filling, and include pulse-size distributions and calibrations obtained with X-rays from Mo and the γ-ray line from RaD + E + F. Electron attachment effects with ethyl formate are demonstrated. J.D.Craggs

537.542

3793. ON LARGE SCINTILLATION COUNTERS. D.Brini, L.Peli, O.Rimondi and P.Veronesi.
Nuovo Cimento Suppl. (Ser. 10), Vol. 2, No. 4, 1048-74 (1955).

A general consideration is given to the design problems of large volume counters. Topics dealt with include geometry and enclosure of scintillator, non-uniform response of photocathode, non-uniform light distribution on the cathode and time of light collection. G.F.J.Garlick

537.542

3794. SCINTILLATION SPECTROMETRY USING LONG LIGHT GUIDES. P.A.Tove.
Rev. sci. Instrum., Vol. 27, No. 3, 143-6 (March, 1956).

The attenuation of different types of light guides used with scintillation counters has been measured. The detrimental effect of the guides in scintillation spectrometry has been studied. A.

537.542

3795. A HALF-LITER "CLEAN" BUBBLE CHAMBER. P.Bassi, P. Mittner and I.Scotoni.
Nuovo Cimento (Ser. 10), Vol. 2, No. 6, 1334-5 (Dec., 1955).

The successful construction and operation of a piston operated pentane "clean" bubble chamber is reported. The chamber consists of a square section Pyrex bottle, having a useful volume of 450 cm^3, mounted in a pressurized thermostatic bath. The chamber is expanded at random whilst a counter coincidence triggers the flash. Cosmic-ray photographs of tracks are taken with various delays. The growth of the bubbles is found to be in agreement with theoretical predictions. G.Martelli

537.543

3796. TRENDS IN TRIODES. C.L.Andrews.
Amer. J. Phys., Vol. 23, No. 8, 495-9 (Nov., 1955).

In each decade prophets predict the maximum frequency which triode oscillators may ever attain. In each decade the limit is revised upward by a factor of two. The present upper limit for commercial triodes is about 6000 Mc/s (5 cm wavelength). For each demonstration in physical optics there is a most convenient wavelength. Waves of 12 cm are most convenient for classroom demonstrations of the Fresnel diffraction. For the Fraunhofer and Bragg diffraction 5 cm waves are better. A microwave spectrometer for 5 cm is described. A.

537.543 : 621.385.1

3797. ORIGIN AND ANALYSIS OF GAS IN ELECTRON TUBES. S.J.Stoll.
Brit. J. appl. Phys., Vol. 7, No. 3, 94-6 (March, 1956).

It is shown that the gas liberated in an electron tube, during electron bombardment of the anode, originates in the oxide-coated cathode. This gas was found, by spectrographic analysis to be nearly all carbon monoxide. The significance and relative effects of tube processing on tube gas are shown. A.

IONIZATION. THERMIONICS 537.56/58

537.56 : 537.52

3798. IONIZED GASES. A.von Engel.
Oxford: Clarendon Press; London: Geoffrey Cumberlege (1955) x + 281 pp.

This textbook, which will be of interest to all concerned with ionization phenomena, gives a concise discussion of the processes which occur in electrical discharges in gases and their role in various kinds of discharge. The main contents are as follows: Chap. I is devoted to a very brief historical introduction. Chap. II deals with the electrical conductivity of gases under low electric fields when ionization is produced by an external source. It includes a quantitative treatment of the dependence of current density upon electric field in a feebly ionized gas and also of the influence of the presence of space charges in both uniform and non-uniform applied fields. It ends with a short note on the determination of the instantaneous current flowing when a charge moves between electrodes: this is the basic principle which underlies some of the most recent measurements of drift velocities (Abstr. 5802/1952). Fundamental collisional processes, ion and electron scattering, and ionization and excitation by collisional and thermal processes are treated extensively in Chap. III. Electron and ion liberation at solid surfaces due to the incidence of electrons, ions, excited atoms and photons as well as thermionic ion and electron emission and field emission processes are also described. Chap. IV is devoted to a treatment of the mobilities of electrons and ions and the important influence of charge exchange. Methods of measurements of these quantities are briefly discussed. Chap. V gives a short but detailed account of the diffusion and mutual repulsion of charged particles in gases, and also in vacuo, in the presence of electric and magnetic fields. The various types of recombination process between positive ions and electrons and between positive ions and negative ions which occur in gases at low and high pressures, following the work of Thomson and Langevin and more recent developments, is given a detailed treatment in Chap. VI. Methods of measurement of the recombination coefficients for ion—ion and electron—ion recombination are described. Chap. VII, entitled "Ionization in an Electric Field", deals mainly with the spatial growth of ionization currents in gases under uniform and non-uniform electric fields due to the action of the Townsend primary (α) and secondary ionization processes which lead to breakdown, and with the prediction of the breakdown potential. The Townsend relation for ionization growth and the breakdown criterion are derived and compared with experimental observations. The well known semi-empirical relationship between the primary coefficient (α) gas pressure (p) and electric field (X), $\alpha/p = A \exp\left[-B/(X/p)\right]$, is considered and compared with observations, and its validity discussed. Statistical and formative time lags are briefly considered. The main electrical and some optical properties of the various sections of glow discharges are examined in detail in Chap. VIII. The treatment of this subject is a modified version of that given previously by the author in his works with Steenbeck (A.von Engel and M.Steenbeck, Elektrische Gasentladungen, Vols. 1 and 2 Berlin: Springer Verlag, 1932-34). Potential, field and charge distributions in cathode fall and pos. column regions, current—voltage characteristics, electron temperature and other important parameters of various types of glow discharge are investigated. The last chapter is devoted to a discussion of the properties of the arc discharge, and, in particular, the optical, thermal and electrical properties of the phenomena occurring in the positive column, measurements based on these phenomena, cathode processes, cold arcs and anode phenomena. This is followed by appendices dealing with the similarity principle in discharges, the principle of detailed balancing, energy distribution functions, photoionization by black-body radiation and the theory of plane probes. The book is well illustrated throughout with numerous figures and includes a large number of useful tables of data and numerical examples. There is an extensive bibliography. C.G.Morgan

537.562

3799. RECOIL PARTICLES FROM Po^{210} AND THEIR IONIZATION IN ARGON AND HELIUM. W.P.Jesse and J.Sadauskis.
Phys. Rev., Vol. 102, No. 2, 389-90 (April 15, 1956).

The average energy W_r to make an ion pair for the recoil particles ejected by the disintegration of Po^{210} has been measured in A and He by a modification of a very old method. The ratio of this value for the recoil particles to the corresponding W_α value for Po^{210} α-particles was found to be 4.1 and 4.5 in He and A respectively. The ratio for A agrees well with an earlier determination by Madsen for an argon—air mixture. The maximum radial distance traversed by the recoil particles was found to be 7.7×10^{-3} cm and 52×10^{-3} cm in A and He, respectively, under standard conditions. A.

537.565

3800. SIZE, MOBILITY AND CHARGE OF MULTIPLY CHARGED IONS. P.J.Nolan and T.C.O'Connor.
Proc. Roy. Irish Acad. A, Vol. 57, No. 10, 161-71 (Dec., 1955).

The investigation was made to check earlier work by J.J.Nolan and O'Keeffe [Proc. Roy. Irish Acad., Vol. 41, 26-40 (Jan., 1933)], which indicated that the mobility of multiply charged ions was independent of charge. Ions were produced by bubbling filtered air through distilled water. The results did not fit the well-known relation $W/nD = e/kT$ between mobility, charge and diffusion coefficient. An explanation of this discrepancy is suggested in terms of a non-equilibrium charge distribution at the time of measurement. Comment is also made on a theory of balloelectricity. A.E.Kay

537.567

3801. ATOMIC NEGATIVE-ION-PHOTODETACHMENT CROSS-SECTION AND AFFINITY MEASUREMENTS. S.J.Smith and L.M.Branscomb.
J. Res. Nat. Bur. Stand., Vol. 55, No. 3, 165-76 (Sept., 1955).

The spectral distributions of the H^- and O^- cross-sections for photodetachment have been measured. The H^- measurements are consistent with the theory of Chandrasekhar (1945). A curve has been fitted to the results for O^-. The threshold of this cross-section, the affinity of O^-, is found to be 1.48 ± 0.10 eV. No evidence is found for resonance at the threshold or for the existence of excited O^- ions. The apparatus is described in detail. A.

537.583

3802. THERMIONIC CONSTANTS OF SEMI-CONDUCTORS. K.S.Krishnan and S.C.Jain.
Nature (London), Vol. 177, 285 (Feb. 11, 1956).

The effusion method (Abstr. 5868/1952, 2516/1953) has been applied to oxide-coated filaments, which are stacked inside the graphite vessel. The values found were $\phi = 1.55$ eV, $A = 48$ A.cm^{-2}.^{0}K^{-1}. This value of A corresponds with $d\phi/dT = 8 \times 10^{-5}$ eV/^{0}K. A.H.W.Beck

COSMIC RAYS 537.591

537.591

3803. ALBEDO OF COSMIC RAYS IN THE EARTH'S DIPOLE AND QUADRUPOLE MAGNETIC FIELD. R.Gall and J.Lifshitz.
Phys. Rev., Vol. 101, No. 6, 1821-4 (March 15, 1956).

Albedo trajectories for protons of 0.5, 1.0, 1.5 and 2.0 BeV in the earth's dipole and quadrupole magnetic field are computed. The zenithal, azimuthal, latitude, and magnetic rigidity effects are studied. The quadrupole induces an asymmetry

which seems only to be important near the geomagnetic equator. Shadow cones were obtained for one point of incidence. A.

537.591 : 537.542

3804. A HIGH PRESSURE CLOUD CHAMBER FOR COSMIC RAY OBSERVATION. S.Miyake.
J. Phys. Soc. Japan, Vol. 11, No. 3, 195-201 (March, 1956).

A chamber 50 cm in dia., 20 cm deep and used at 150 atm., was built in 1952. It can be operated automatically by counter control with a recycling time of about 20 minutes. It was filled with 5.6 kg of nitrogen or 8 kg of argon gas in its illuminated space of about 30 litres, and it was found easier to observe some cosmic-ray phenomena, especially those events occurring in the gas nuclei, than when using a smaller chamber.
A.

537.591.1

3805. ON THE DEVELOPMENT OF THE ATMOSPHERIC PHOTON COMPONENT. G.Poiani.
Nuovo Cimento (Ser. 10), Vol. 2, No. 5, 1114-18 (Nov., 1955). In Italian.

Using the Mellin Transformation (M.T.) method, quantitative estimates of the contributions of the following three processes to the integral cosmic-ray photon spectrum in the atmosphere are given: (a) $\pi^0 \rightarrow 2\gamma$. The M.T. of the various differential spectra involved (primary nucleon, nucleon cascade, π production etc.) are taken from the literature. (b) $\mu \rightarrow e + \nu + \nu$. An empirical μ production spectrum is assumed in agreement with the work of Puppi and Dallaporta. (c) Knock-on electrons from μ-mesons. The results are presented in the form of intensity-depth curves. A photon-electron ratio curve (as a function of depth) is also given.
R.H.W.Johnston

537.591.1 : 523.165

ORIGIN OF COSMIC RADIATIONS. See Abstr. 2617

537.591.1 : 523.165

MODIFIED FERMI MECHANISM FOR THE ACCELERATION OF COSMIC RAYS. See Abstr. 2618

537.591.1 : 778.34

3806. SPURIOUS SCATTERING IN NUCLEAR EMULSIONS. E.Lohrmann and M.Teucher.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 59-65 (Jan., 1956).

In full agreement with the results of Biswas, Peters and Rama (Abstr. 7171/1955) further evidence is presented concerning a new form of noise in scattering measurements in nuclear emulsions, which is supposed to be produced by small dislocations in the emulsion and appears to be found in every kind of emulsion. As its mean sagitta increase is roughly proportional to the cell length, it can be mistaken for true Coulomb scattering and affects scattering measurements at $p\beta > 2$ GeV/c very seriously. As a possible consequence the mean energy leading to a given multiplicity of shower particles seems to have been greatly underestimated. Furthermore the effect could give a bias towards low mass values in mass determinations of particles of high energies by the scattering–ionization method. The ratio of third to second differences was found to be 1.45 ± 0.034, also not far from the value 1.30 given for Coulomb scattering. A.

537.591.15

3807. INELASTICITY COEFFICIENTS IN COSMIC-RAY JETS. G.Bertolino.
Nuovo Cimento (Ser 10), Vol. 2, No. 5, 1130-1 (Nov., 1955). In Italian.

In an attempt to minimize effects other than those due to simple nucleon–nucleon (n–n) collisions, outer tracks which made angles with the cores of the jets more than 1.5 times those made by their neighbours were excluded. There were 78 such among the 516 tracks of the 59 jets examined. A mean inelasticity coefficient $K = 0.46 \pm 0.21$ was obtained which included no "anomalous" values greater than unity. Dividing the jets into the "zones A and B" of Dilworth et al. (Abstr. 7120/1953) and Hoang (Abstr. 7950/1953), values of K were obtained which differ significantly: 0.52 ± 0.21 and 0.18 ± 0.12 respectively. The latter jets were of higher energy for a given number of tracks. It is concluded that there is an approximately linear relation between the energy liberated in an n–n collision and the number of mesons produced.
R.H.W.Johnston

537.591.15

3808. COSMIC RAY SHOWERS OF WIDE EXTENT. G.R.Macleod.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 118-25 (Jan., 1956).

Extensive air showers have been observed at sea level, using a maximum counter tray separation of 1200 m, by a method allowing a direct determination of the angular distribution of the shower axes to be made; it is found to be proportional to $(\cos\theta)^{6.5 \pm 0.5}$. Comparison of the decoherence rates of the showers with nucleon cascade theory predictions, shows that the angular dependence of the nucleon collision cross-section which determines the lateral spread of the shower, is very sharply peaked in the forward direction. The shower rates are compatible with the known rates of electron–photon cascades at sea level, if each of these is considered to be associated with a penetrating cascade of much larger spread and lower particle density. The penetrating cascade carries about 1/5-th of the total shower energy, and contains about 1/10-th of the total number of particles in the shower at sea level. A.

537.591.15

3809. ON COSMIC RAYS JETS. G.Bertolino.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 141-51 (Jan., 1956).

An examination of 59 jets found in the scanning of nuclear plates exposed to cosmic radiation during the Sardinia Expedition of 1952 and 1953. Studying the angular distribution of jet-tracks, a substantial and abrupt increase of the angle has been noted at the last tracks, which increase can be considered as due to secondary phenomena after the primary collision. The primary energy and anelasticity coefficient of jets has been calculated, excluding the tracks considered as due to secondary phenomena: the jets can consequently be divided into two classes having as mean value for the anelasticity coefficients 0.52 and 0.18, respectively. The incongruency arising from the fact that in previous works values of the anelasticity coefficient greater than 1 have been calculated has been eliminated. A.

537.591.15

3810. THE RATE OF EXTENSIVE SHOWERS OF HIGH ELECTRON DENSITY AT SEA LEVEL. C.B.A.McCusker and B.G.Wilson.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 188-94 (Jan., 1956).

Extensive air showers of high electron density (average density ~ 700 particles/m^2) have been observed at sea level. The rates of all classes of events with respect to sidereal time are constant within the statistical errors. With respect to solar time however a variation of amplitude ~ 20% and period 12 hours has been found. This variation is out of phase with the previously observed variation of high-energy local penetrating showers. Both are correlated with the oscillations of the atmosphere. A.

537.591.15

3811. LATERAL STRUCTURE OF EXTENSIVE AIR SHOWERS. D.S.Narayan.
Phys. Rev., Vol. 101, No. 6, 1815-21 (March 15, 1956).

The problem presented by air showers which have particle densities ~ 500 per sq. metre around the shower axis and which have no multiple peaks with separations of more than a metre has been analysed previously by Hazen et al. using Fermi's model of meson production. The object of this paper is to show that, contrary to the conclusion of Hazen et al., Fermi's model cannot generate such showers. On the other hand, it is shown

at a modification by Bhabha, to the phenomenological models meson production, which predicts greater angular concentation of the mesons produced in nucleon–nucleon collisions, in generate the showers of the type referred to above for a uitable choice of the parameter ϵ, which in this theory is the atio of field mass to proper mass. A.

537.591.15

3812. AN EXPERIMENT WITH COUNTERS ON PENETRATING SHOWERS PRODUCED BY μ MESONS. D.Kessler and R.Maze.
Physica, Vol. 22, No. 2, 69-85 (Feb., 1956). In French.

A penetrating shower counter-arrangement has been operated at sea-level, and at 10 and 65 m.w.e. underground. The contribution of soft showers produced by μ-mesons was made negligible by using at least 18.5 cm Pb as absorber between extreme counter-trays. The analysis of hodoscopic data obtained with different absorber thicknesses made it possible to separate multiple electromagnetic interactions from true penetrating showers. Triggering by associate penetrating particles either from the atmosphere or from the earth seems to be unimportant, as follows from the rather localized distribution of small multiplicities. The following cross-sections for production of penetrating showers by μ-mesons with at least 2 secondary particles able to penetrate 18.5 cm Pb were obtained: at 10 m.w.e. underground: $(1.16 \pm 0.54) \times 10^{-30}$ m^2/nucleon; at 65 m.w.e. underground: $(1.22 \pm 0.45) \times 10^{-30}$ m^2/nucleon. The cross-section given for the 10 m.w.e. level might have been overestimated by 10% due to a contribution from residual N-component from the atmosphere. The ratio of the cross-sections at 65 and 10 m.w.e. is 1.05 ± 0.24 showing that the cross-section does not increase faster than the logarithm of the mean energy of the μ-mesons arriving at each level, but, as far as one may conclude from the rather poor statistics, the absorption mean free path of the secondary shower particles which trigger the apparatus is about twice as long at 65 m.w.e. than at 10 m.w.e. underground. The frequency distributions at 10 and 65 m.w.e. of the number of secondary penetrating particles are neither significatnly different from each other nor from the distribution of penetrating showers produced at sea-level by the N-component. The observed distributions are found to be compatible with a law of the form $\varphi(N) = (N - 1)^{-a}$ with $a \sim 2$, N being the number of secondary shower particles. A.

537.591.5

3813. EFFECT OF LUNAR ATMOSPHERIC TIDE ON THE MESON INTENSITY AT KODAIKANAL. D.Venkatesan and V.S.G.Shastry.
Proc. Indian Acad. Sci. A, Vol. 42, No. 4, 204-14 (Oct., 1955).

The lunar semidiurnal variation in the meson intensity at Kodaikanal has been determined by the Chapman–Miller method of analysis from bihourly records of the cosmic-ray meson intensity registered by three-fold coincidences for two consecutive groups of data, each extending over a period of 18 months. The former period gives a result about two to three times the probable error and can be taken to be significant. While the correlations between the solar diurnal variation of meson intensity and barometric pressure are high and negative, the corresponding correlations between the lunar semidiurnal variations of meson intensity and barometric pressure are positive. The results obtained at Kodaikanal agree with those of Duperier obtained at London. But the latter period does not give any significant result outside the probable error. Hence further investigation has to be continued. A.

537.591.8

3814. ON THE ANALYSIS OF THE SLOW PARTICLES EMITTED FROM COSMIC-RAY STARS. I. S.Nakagawa, T.Tamai, H.Huzita and K.Okudaira.
J. Phys. Soc. Japan, Vol. 11, No. 3, 191-5 (March, 1956).

An analysis of the nature of tracks of the stars ending in C5 emulsion was made by measuring their width (diameter). Six groups of tracks having different width were observed. Two of these groups are identified as consisting of α-particles and Li nuclei by comparing their width with those of α-particles emitted from radiothorium stars and with those of hammer tracks. As for the thicker tracks, the charge determination on the tracks of each group was made by measuring their thin-down lengths. These measurements seem to indicate that the width of track was approximately proportional to $\sqrt{Z}$ (Z = atomic number). The energy and the angular distribution of each group were also examined. The curves of the energy distribution of protons and α-particles approximately agreed with those deduced from the evaporation model, assuming the appropriate nuclear temperature and Coulomb barrier height. The angular distributions of these were nearly isotropic. It was noted that the number of slower α-particles measured seems to be considerably larger than that deduced from theory. A.

MAGNETISM 538

538.114

3815. APPLICATION OF NEUTRON DIFFRACTION TO THE STUDY OF ANTIFERROMAGNETISM. A.Johannin-Gilles.
J. Phys. Radium, Vol. 17, No. 1, 72-6 (Jan., 1956). In French.

Outlines the theory of antiferromagnetism, according to which the occurrence of the phenomenon arises from the presence of neighbouring parallel and anti-parallel magnetic spins, and describes how neutron diffraction may be applied to a study of antiferromagnetic problems, the magnetic scattering of neutrons (which arises from the interaction of the neutron and atomic magnetic moments) depending on the direction of the atomic spin. Examples are given of the application of neutron diffraction to MnO, FeO and similar compounds, Fe_2O_3, MnF_2 and similar compounds, and to the transition metals. A bibliography of 35 papers is given.
J.Thewlis

538.114

3816. ON THE MAGNETIC ANISOTROPY OF FeF_2 AND CoF_2. T.Moriya, K.Motizuki, J.Kanamori and T.Nagamiya.
J. Phys. Soc. Japan, Vol. 11, No. 3, 211-25 (March, 1956).

The magnetic anisotropies of FeF_2 and CoF_2 are studied in detail by calculating the crystalline field acting on their magnetic ions and considering the effect of the spin–orbit coupling. The electronic energy level splittings of the ions Fe^{++} and Co^{++} in the crystalline field are calculated assuming first that all the surrounding ions are point charges, and then taking account of the overlapping of their 3d electrons with the electron clouds of the surrounding fluorine ions. The spin–orbit coupling is then introduced and the g-values are calculated. Further, introducing exchange coupling in the approximation of molecular field, the parallel and perpendicular susceptibilities of FeF_2 are calculated and a reasonable agreement is found. For CoF_2, however, the calculated level splitting is not successful in explaining the observed susceptibilities. The possible sources of this disagreement and the nature of the approximations made are discussed. A.

538.114

3817. SUBSIDIARY ABSORPTION PEAKS IN FERROMAGNETIC RESONANCE AT HIGH SIGNAL LEVELS. H.Suhl.
Phys. Rev., Vol. 101, No. 4, 1437-8 (Feb. 15, 1956).

Gives an interpretation of the finding of Bloembergen and others that at high power levels there is an additional absorption peak at a d.c. field considerably below that required for resonance. The effect is attributed to an instability of spin precession similar in some respects to that discussed in Abstr. 2226 (1956). E.P.Wohlfarth

538.114

3818. SPIN-DEVIATION THEORY OF FERROMAGNETISM. I. GENERAL THEORY. J.van Kranendonk.

Physica, Vol. 21, No. 10, 749-66 (Oct., 1955).

A theory is developed of the properties of a ferromagnetic spin system of the Heisenberg exchange type for spins $\frac{1}{2}$, in which the spin deviations (wrong spins) rather than the spin waves constitute the basic elements of the theory. It is shown that because of an inherent difficulty in the usual spin-wave formalism, this formalism cannot be used if it is desired to go beyond the Bloch spin-wave approximation. The spin-deviation theory is therefore derived directly from the Hamiltonian of the spin system by introducing the wave-functions describing the motion of the spin deviations through the lattice. The wave equations satisfied by these wave-functions admit of a simple interpretation in terms of kinetic and potential energy operators, and this enables one to introduce the concept of a gas of spin deviations interacting according to a simple, additive potential. A general relation is derived between the partition function of this spin-deviation gas and the spin system. The ideal-gas law which is obtained by neglecting the interaction between the spin deviations, leads to the Bloch spin-wave approximation. The interaction between the spin deviations can be investigated by applying the standard methods used in the theory of ordinary gases and liquids to the spin-deviation gas. The application of the virial expansion is discussed in detail, and it is shown what this expansion implies for the spin system. Some other applications of the spin-deviation theory are also discussed. A.

538.114

3819. SPIN-DEVIATION THEORY OF FERROMAGNETISM. II. THE NON-IDEAL SPIN-DEVIATION GAS. J.van Kranendonk.

Physica, Vol. 21, No. 12, 925-45 (Dec., 1955).

The low-temperature approximation to the equilibrium properties of a ferromagnetic spin system of the Heisenberg type, obtained in Pt I by applying the virial expansion to the spin-deviation gas describing the spin system, is worked out in detail. First, the ideal-gas approximation is discussed and shown to be equivalent to the spin-wave approximation of Bloch. The influence of the binary collisions occurring in the spin-deviation gas as a result of the interaction between the spin deviations is then investigated by calculating the second virial coefficient of the spin-deviation gas with the help of the previously derived wave equation for the relative motion of two spin deviations. In this binary-collision approximation, the deviation of the spontaneous magnetization from its saturation value is shown to follow a law of the form $aT^{3/2}(1 + bT^{1/2})^{-1}$ for about $0.05 \leq T/T_C \leq 0.4$, where T_C is the Curie temperature. For $T/T_C < 0.05$, a power series development may be made, which turns out to be of the form $a'T^{3/2}(1 + b'T^{1/4} + \ldots)$, where $a' = 1.52a$. The ideal-gas approximation, i.e. the Bloch $a'T^{3/2}$ law, is shown to be valid only at very low temperatures, $T/T_C < 10^{-4}$. It is pointed out that the value of the coupling constant J determined by fitting the $T^{3/2}$ law of Bloch to the experimental curve for the spontaneous magnetization is about a factor 1.7 too large. The large influence of the binary collisions even for very small densities of the spin-deviation gas is shown to result from the fact that the ideal spin-deviation gas is in a state in which it is very susceptible to small perturbations. Finally, the influence of the binary collisions on the susceptibility is determined. For small field, the susceptibility is found to approach to a constant value, the $B^{-1/2}$ law for the field dependence in the ideal-gas approximation being also valid only at very low temperatures. A.

538.221

3820. LAW OF APPROACH TO SATURATION OF A SINGLE CRYSTAL OF Fe-Si IN THE THREE PRINCIPAL CRYSTALLOGRAPHIC DIRECTIONS. H.Danan.

C.R. Acad. Sci. (Paris), Vol. 242, No. 6, 748-50 (Feb. 6, 1956). In French.

Reports results on the field dependence of the magnetization of a 4% Fe-Si crystal. For internal fields between 10^3 and 2.7×10^4 oersted the law of approach is $I = I_0(1 - a/H)$, where $I_0 = 1644$ gauss and the a-values parallel to the [100], [110] and [111] axes are respectively 22.4, 26.5 and 28.0. E.P.Wohlfarth

538.22

3821. FREQUENCY DOUBLING IN FERRITES. W.P.Ayres P.H.Vartanian and J.L.Melchor.

J. appl. Phys., Vol. 27, No. 2, 188-9 (Feb., 1956).

The torque equation for the motion of the magnetization in a magnetized ferrite yields a component along the direction of the applied d.c. magnetic field. The time dependent part of this component is of second order in r.f. quantities and has previously been neglected. With high incident powers an observable double frequency output is predicted. A high intensity microwave magnetic field and an orthogonal d.c. magnetic field were applied to a ferrite body. Double frequency magnetic fields were generated in the same direction as the d.c. magnetizing field. A primary frequency of 3175 Mc/s was used with peak powers up to 200 watts. The peak output power at 6350 Mc/s was found to increase linearly with the square of the peak input power over a range of 42 db. Reasonable agreement was found between theory and experiment. A

538.221

3822. NUCLEAR MAGNETIC RELAXATION IN ANTIFERROMAGNETICS. T.Moriya.

Phys. Rev., Vol. 101, No. 4, 1435-6 (Feb. 15, 1956).

Gives results of a calculation of the transition probability corresponding to the inelastic scattering of spin waves by nuclear magnetic moments, and compares the results with experimental values of the spin-lattice relaxation time for proton resonance in $CuCl_2.2H_2O$. E.P.Wohlfarth

538.221

3823. RESONANCE WIDTHS IN POLYCRYSTALLINE NICKEL–COBALT FERRITES. M.H.Sirvetz and J.H.Saunder

Phys. Rev., Vol. 102, No. 2, 366-7 (April 15, 1956).

The width of the ferromagnetic resonance has been measured at 10 000 Mc/s in polycrystalline mixed ferrites of the composition $Co_\alpha Ni_{1-\alpha}Fe_2O_4$, with α between 0 and 0.04. The minimum line width is found for $\alpha = 0.025$ at 20°C. This, as well as the variation of line width with temperature, can be understood on the basis of known single crystal properties and the following assumptions; (a) line width is a linear function of $|K|$; (b) crystal anisotropy is an additive atomic property. A.

538.221 : 536.48

3824. FERROMAGNETIC RESONANCE ABSORPTION IN A NICKEL SINGLE CRYSTAL AT LOW TEMPERATURES. K.H.Reich.

Phys. Rev., Vol. 101, No. 6, 1647-8 (March 15, 1956).

The g-value and line width of the ferromagnetic resonance in nickel is found to be the same at 4°K as at room temperature. A small effect due to inhomogeneous magnetization in the skin depth, predicted by Kittel and Herring, has been observed. Values for the anisotropy constants at 4.2°K are $K_1 = -8.3 \times 10^4$ ergs/cm^3, $K_2 = -1.4 \times 10^5$ ergs/cm^3. A.

538.221 : 538.652

3825. DYNAMIC MAGNETOSTRICTIVE PROPERTIES OF ALFENOL. C.M.Davis and S.F.Ferebee.

J. Acoust. Soc. Amer., Vol. 28, No. 2, 286-90 (March, 1956).

The magnetostrictive properties of Alfenol, a cold-rolled Al-Fe alloy, were investigated to determine its suitability for use in electromechanical transducers. The effects of various processing techniques are included. The material, in the form of laminated toroids, was evaluated by the motional impedance method. Measured values of the electromechanical coupling coefficient, the mechanical Q in air, the reversible permeability, the dynamic magnetostrictive constant, and other parameters are given. The measurements indicate that the performance of 12- or 13-Alfenol is comparable to that of nickel, at

least for low-power applications. The electromechanical coupling coefficient (approximately 0.29) is comparable to that of nickel; the electrical resistivity is at least ten times greater than that of nickel. A.

538.221 : 538.652

3826. MAGNETOSTRICTIVE EFFECTS IN AN ANTIFERROMAGNETIC HEMATITE CRYSTAL. H.M.A.Urquhart and J.E. Goldman.
Phys. Rev., Vol. 101, No. 5, 1443-50 (March 1, 1956).

Magnetostrictive distortions in an antiferromagnetic natural single crystal of haematite were studied in the region of the transition near $-25^{\circ}C$, where the antiferromagnetic axis spontaneously shifts its crystallographic direction by 90°. The magnetostriction is shown to be closely related to the parasitic magnetization and is interpreted in terms of the existence of domain walls separating antiferromagnetic domains. A.

538.221 : 539.26 : 548.736.3

3827. CHANGES IN LATTICE CONSTANT OF Cr_2O_3 NEAR THE CURIE TEMPERATURE. S.Greenwald.
Nature (London), Vol. 177, 286-7 (Feb. 11, 1956).

See Abstr. 9597 (1951). Re-examination of previous results shows that the c-axis lengthens as the material is cooled through the antiferromagnetic transition region, whereas the a-axes decrease in a non-linear fashion in the same temperature range. New observations confirm these results. A.E.De Barr

538.221 : 548.7

3828. ANTIFERROMAGNETIC RESONANCE AT LOW FREQUENCY. G.E.G.Hardeman and N.J.Poulis.
Physica, Vol. 21, No. 9, 728-36 (Sept., 1955).

When interacting with a very small or zero external magnetic field the antiparallel spins in an antiferromagnetic single crystal have fixed orientations along the most preferred axis. This preferred direction is due to the anisotropy energy. In increasing external fields the spins deviate from this preferred direction, the deviation depending on direction and strength of the external field and on temperature. At certain field strengths and directions, a transition occurs in which the spins flop over and orientate approximately perpendicular to the field. At these so-called threshold or critical fields electron resonance absorption can be found at low frequencies. The critical fields were therefore determined by adjusting the external field for maximum absorption. The measurements were done on the orthorhombic single crystal of $CuCl_2.2H_2O$ which is antiferromagnetic below about $4.3^{\circ}K$. A.

538.222

3829. PARAMAGNETIC RESONANCE OF Mn^{2+} IN CUBIC ZnS AT LOW TEMPERATURES. K.A.Müller.
Helv. phys. Acta, Vol. 28, No. 5-6, 450-2 (1955). In German.

538.222

3830. PARAMAGNETIC RESONANCE IN $Cu(NH_3)_4SO_4.H_2O$. E.H.Carlson and R.D.Spence.
J. chem. Phys., Vol. 24, No. 2, 471 (Feb., 1956).

538.222

3831. ELECTRON SPIN RESONANCE IN METALS AND METAL-AMMONIA SOLUTIONS. R.A.Levy.
Phys. Rev., Vol. 102, No. 1, 31-7 (April 1, 1956).

Electron spin resonance measurements have been made at 00 Mc/s on frozen metal ammonia solutions, liquid metal ammonia solutions, and liquid metals. The experiments on frozen solutions have shown that the metal is precipitated out in small particles. Nuclear resonance experiments have corroborated this finding. The frozen solutions are used as a convenient source of small particles, and observations have been made of relaxation times in Na, Li, K, and Cs. Resonances in the liquid ammonia solutions of Li, Na, K, Rb, Cs, and Ca, and also in a solution of Li in methylamine were observed. The data are consistent with the theoretical model of Kraus, Ogg, and Kaplan and Kittel. Bulk metal resonances were observed to temperatures above the melting points on lithium and sodium. The results for sodium corroborate the Elliott theory of relaxation, and the lithium results indicate resistivity-dependent relaxation time. No resonance was observed in bulk K, Rb, and Cs carried to temperatures above their melting points. A.

538.222

3832. MAGNETIC RESONANCES OF PROTONS IN ETHYL ALCOHOL. J.T.Arnold.
Phys. Rev., Vol. 102, No. 1, 136-50 (April 1, 1956).

Studies have been made of the proton magnetic resonances of ethyl alcohol under considerably higher resolution than has heretofore been reported. A description of the apparatus includes details of construction of a large permanent magnet, with some of the considerations directed toward improvement of resolution by reduction of field inhomogeneities. Also, the features of a specially designed nuclear magnetic resonance head are described. This head is provided with facilities for spinning the sample for the further reduction of the effective field inhomogeneity. Considerations of stability of the field and the radio-frequency components are briefly discussed. Recordings of the observed spectra of ethyl alcohol are shown and are related to the predictions of calculations based on the use of a Hamiltonian which includes a particularly simple form of spin-spin interaction. The features of the spectra are finally resolved to about $\frac{1}{2}$ c/s in 30 Mc/s, and the agreement between predicted and observed structures is reasonably good. The spectra were found to be strongly modified by the presence or almost complete absence of contamination of the ethyl alcohol by H^+ or OH^- ions. The effect is attributed to an exchange process involving the hydroxyl proton of the ethyl alcohol molecule. The characteristic times between exchange events have been approximately determined for specified concentrations of H^+ and OH^- ions up to the order of 10^{-5} normal. A.

538.222

3833. NUCLEAR MAGNETIC RESONANCE SPECTRA OF SOME HYDROCARBONS. W.A.Anderson.
Phys. Rev., Vol. 102, No. 1, 151-67 (April 1, 1956).

The study of the nuclear magnetic resonance spectrum of protons in ethyl alcohol (preceding abstract) has been extended to other liquid compounds which are more amenable to an exact calculation of their energy levels and transition probabilities under the influence of a small radio-frequency perturbation. Resulting recordings of these spectra are shown to be in agreement with the spectra predicted by a simple Hamiltonian proposed by Hahn and Maxwell as well as by Gutowsky, McCall and Slichter. New evidence has been found which indicates that lines in a given spectrum have different widths. A method has been demonstrated whereby a definite spin coupling may be associated with a definite group of nuclei. This is achieved by simultaneously applying a large radio-frequency field with a frequency near to the resonance frequency of one group of nuclei and a small radio-frequency field to produce transitions within another group. In this case any structure due to the spin coupling between the two groups is greatly modified. A new and simple procedure has been demonstrated whereby the magnitude of the radio-frequency field at the sample may be accurately determined with the aid of a small auxiliary radio-frequency field. A.

538.222

3834. SOME MEASUREMENTS ON THE SPECTRAL LINE SHAPE AND WIDTH OF A PARAMAGNETIC RESONANCE ABSORPTION LINE. F.Bruin and M.Bruin.
Physica, Vol. 22, No. 2, 129-40 (Feb., 1956).

Paramagnetic resonance of the free radical DPPH was measured at a frequency of 20 Mc/s by means of a simple autodyne detector. The results of the experiments are compared with the Anderson-Weiss model of exchange narrowing.

In agreement with this theory a Lorentz line shape is found. The half-value width decreases with increasing temperature and is larger than the value at microwave frequencies. The width as a function of concentration shows a sharp increase going from the crystalline state to the solution in a liquid. The imaginary peak susceptibility χ'' is measured and found to be in agreement with the theoretical value. A.

538.222

3835.. PARAMAGNETIC RESONANCE IN SOME CUPRIC SALTS. K.Sundaramma.
Proc. Indian Acad. Sci. A, Vol. 42, No. 6, 292-302 (Dec., 1955).

Data for cupric oxalate, cupric sodium oxalate, cupric potassium oxalate and cupric ammonium oxalate in the powder form have been obtained. Single crystals of cupric ammonium oxalate dihydrate and cupric formate tetrahydrate have been investigated for anisotropy of "g" value and line-widths. No resonance was observed in cupric butyrate monohydrate in a magnetic field ranging from 0 to 4500 gauss in the region of 3 cm. Structure of the crystals are discussed in relation to the magnetic properties of the same. A.

538.222 : 548.7

3836. SPIN RESONANCE IN V-CENTERS. M.H.Cohen.
Phys. Rev., Vol. 101, No. 4, 1432-3 (Feb. 15, 1956).

Suggests that the electron spin resonance of X-irradiated KCl (Abstr. 1390/1956) is due to V_3 centres, i.e. Cl_2^- ions, not to V_1 centres. D.H.Whiffen

538.222 : 621.317.4.029.6

3837. SPECTROGRAPH FOR PARAMAGNETIC ELECTRON RESONANCE. G.Berthet.
Onde élect., Vol. 35, 489-90 (May, 1955). In French.

The symmetrical arms of a magic-T are each terminated in cavities formed by closing off the ends of the guide and coupling through a small aperture. One cavity is in the polarizing field, the other not. The field consists of a main component supplied by an iron-cored electromagnet and an exploring incremental field controlled by the source feeding X-sweep to the display oscillograph. The sweep rate is 1 kc/s. The other arms of the T respectively accept input from a 723A/B klystron at about 9400 Mc/s and detect circuit unbalance by a crystal detector. The crystal output is amplified and provides the Y-signal to the oscillograph. The present apparatus will detect 0.04 mg of diphenylpicrylhydrazil. The use of a 5 W klystron is planned to investigate electroluminescence.
S.C.Dunn (R)

538.222 : 621.317.4.029.6

3838. A HIGH RESOLUTION HERTZIAN SPECTROGRAPH ALLOWING THE SEPARATE OBSERVATION OF PARAMAGNETIC ABSORPTION AND DISPERSION IN THE 3 cm BAND. C.Ryter, R.Lacroix and R.Extermann.
Onde élect., Vol. 35, 490-2 (May, 1955). In French.

The usual magic-T, cavity and 2-component field are used. The receiver is a heterodyne with a phase detector whose reference frequency, 1 kc/s, also modulates the source klystron in frequency (deviation 10 kc/s). The mean frequency of the source is stabilized primarily by a Pound arrangement and again by a correcting signal fed via a long time constant from the phase detector. The phase detector measures the frequency change in the cavity, another detector measures the amplitude change in the output. The outputs of measures the amplitude change in the output. The outputs of these two detectors are now commutated in two further p.d.'s at 25 c/s (the frequency of the incremental exploring magnetic field) to give separate records of dispersion and absorption. The sensitivity is such that a change in susceptibility of 10^{-13} can be detected. S.C.Dunn (R)

538.224

3839. ELECTRONIC APPARATUS FOR THE MEASUREMENT OF MAGNETIC SUSCEPTIBILITIES. J.Joussot-Dubi B.Lemanceau and A.Pacault.
J. Chim. phys., Vol. 53, No. 2, 198-205 (Feb., 1956). In French.

A simple, compact electronic arrangement for magnetic susceptibility determination is described. Diamagnetic susce ibility measurements on a number of organic substances giv values in close agreement with those determined by the clas sical method using a high constant magnetic field.
G.I.W.Llewel

538.22

3840. MAGNETIC SUSCEPTIBILITY OF CARBONS AND POLYCRYSTALLINE GRAPHITES. II. H.T.Pinnick and P.Kiive.
Phys. Rev., Vol. 102, No. 1, 58-64 (April 1, 1956).

For Pt I, see Abstr. 6735 (1954). The change in magnetic susceptibility of carbons of varying crystallite sizes resultin from a shift of the Fermi level has been studied by investigat residue compounds of carbons with bisulphate ions. The sus- ceptibility decreases monotonically with the concentration of the ions and the relative decrease is progressively larger fo larger crystallites. As a result, instead of the plateau in sus ceptibility in the case of untreated carbons extending from di meters of 150 A to sizes greater than 1500 A, one finds a ma mum in susceptibility at about 200 A diameter for carbons wi a finite (not too small) ion concentration. The temperature dependence of susceptibility for both untreated carbons and residue compounds has also been studied over the temperatu range from 80°K to 1300°K. The susceptibilities of the untreated carbons all decrease at higher temperatures and tend towards a temperature-independent limit at low temperatures For small crystallites, the rapid decrease begins at higher ambient temperature, and the low-temperature limit is smal The plateau in susceptibility as a function of crystallite size present for all ambient temperatures, but the beginning of th plateau shifts somewhat to smaller crystallite size for highe ambient temperatures. A qualitative discussion is given whic leads to the conclusion that the Landau-Peierls theory is inadequate to explain all the experimental findings if the sim plified band model deduced from other electronic properties carbon is used.

538.2

3841. AN IMPROVEMENT IN THE METHOD OF TRACING HYSTERESIS LOOPS WITH AN ILIOVICI PERMEAMETER. R.Dehors and L.Garde.
C.R. Acad. Sci. (Paris), Vol. 242, No. 6, 751-3 (Feb. 6, 19 In French.

With the standard Iliovici permeameter arrangement it i difficult to obtain many points in the second and fourth quadrants of the B–H diagram since, for these portions of the B- loop, the magnetizing and compensating currents need to be i opposition. An improved commutator to enable compensation to be maintained in these regions is suggested.
A.E. De Ba

538.

3842. THEORY OF REMAGNETIZATION OF THIN TAPES H.Ekstein.
J. appl. Phys., Vol. 26, No. 11, 1342-4 (Nov., 1955).

It is assumed that the velocity of the domain wall is proportional to the difference between the magnetic field intensi at the wall and the coercive force. The local magnetic field, which is not equal to the external field, is calculated from th eddy-current equations. The rate of change of the magnetic flux as a function of time is determined. The total switching time is expressed in terms of two phenomenological constant the retardation constant α mentioned above, and a delay tim the duration of the formative phase during which the plane w are formed.

538.24 : 538.632

3843. HALL EFFECT, SPONTANEOUS MAGNETIZATION AND TEMPERATURE. E.A.Ascher.
Helv. phys. Acta, Vol. 28, No. 7, 667-93 (1955). In French.

Verifies by experiments on irreversible Fe-Ni alloys with Ni content 30% that the extraordinary Hall conductivity is a linear function of the spontaneous magnetization.

E.P.Wohlfarth

ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3 : 532.51 : 523.7 : 550.38

HYDROMAGNETIC PHENOMENA: A REVIEW. See Abstr. 3383

538.52

3844. ELECTROMAGNETIC INDUCTION IN MOVING SYSTEMS. D.R.Corson.
Amer. J. Phys., Vol. 24, No. 3, 126-30 (March, 1956).

The principles underlying the extension of the Maxwell equation curl $\mathbf{E} = -\partial\mathbf{B}/\partial t$ to moving media are discussed, and illustrations with specific moving systems are presented. The principles are applied to the case of the unipolar generator.

A.

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 532.5

3845. A DISCUSSION ON MAGNETO-HYDRODYNAMICS.
Proc. Roy. Soc. A, Vol. 233, 289-427 (Dec. 29, 1955).

A discussion held in May 1955 at which thirteen papers were presented. These are abstracted individually.

538.56 : 532.5

3846. A DISCUSSION ON MAGNETO-HYDRODYNAMICS. INTRODUCTION. E.Bullard.
Proc. Roy. Soc. A, Vol. 233, 289-96 (Dec. 29, 1955).

A review is given of the basic equations of magnetohydrodynamics and of the approximations that enable solutions to be obtained in problems of astronomical and geophysical interest.

A.

538.56 : 532.5 : 523.16

3847. LINE CURRENTS IN COSMIC PHYSICS. A.Alfvén.
Proc. Roy. Soc. A, Vol. 233, 296-8 (Dec. 29, 1955).

Observed cosmic magnetohydrodynamic effects indicate currents concentrated in thin filaments. It is suggested that line currents rather than volume currents may be the normal case in cosmic phenomena.

R.A.Newing

538.56 : 532.5

3848. AN INSTABILITY OF LAMINAR FLOW OF MERCURY CAUSED BY AN EXTERNAL MAGNETIC FIELD. B.Lehnert.
Proc. Roy. Soc. A, Vol. 233, 299-302 (Dec. 29, 1955).

The rotation of a layer of mercury in an axial field is induced by a rotating ring. It is observed that vortices are formed at the boundaries between moving and stagnant regions, the number of vortices increasing with field strength. It is concluded that, under suitable conditions, a magnetic field can give rise to instability rather than to stability in the flow of a conducting liquid.

R.A.Newing

538.56 : 532.5 : 523.7

3849. TORSIONAL OSCILLATIONS AND SOLAR MAGNETIC FIELDS. D.Layzer, M.Krook and D.H.Menzel.
Proc. Roy. Soc. A, Vol. 233, 302-10 (Dec. 29, 1955).

Torsional magneto-mechanical oscillations of finite amplitude in an idealized non-uniformly rotating star that possesses a poloidal magnetic field are governed, in a first approximation, by a pair of linear wave equations. The approximation is valid if the rotational energy and the magnetic energy are small compared with the gravitational energy. Making various assumptions about the form of the poloidal field, numerical estimates are derived for the period of the fundamental mode, and the results discussed as they relate to the problem of solar variability.

A.

538.56 : 532.5 : 523.16

3850. HYDROMAGNETIC WAVES IN RARE IONIZED GAS AND GALACTIC MAGNETIC FIELDS. V.C.A.Ferraro.
Proc. Roy. Soc. A, Vol. 233, 310-18 (Dec. 29, 1955).

An investigation is made into the conditions under which waves analoguous to Alfvén waves may be excited in a rarified gas. The waves, which are shown to arise when the intensity of the permanent magnetic field is less than a certain critical value, have the same phase velocity as Alfven waves but are circularly polarized.

R.A.Newing

538.56 : 532.5

3851. MAGNETO-HYDRODYNAMIC OSCILLATIONS OF A ROTATING FLUID GLOBE. T.G.Cowling.
Proc. Roy. Soc. A, Vol. 233, 319-22 (Dec. 29, 1955).

The effect of Coriolis forces on torsional magnetohydrodynamic oscillations in a gravitating fluid globe is studied. Whereas a non-rotating mass possesses a continuous set of free torsional periods, a rotating mass possesses only a discrete set. The effect on the periods of oscillation may be large for uniform liquid masses, but is likely to be small in real stars.

A.

538.56 : 532.5

3852. HYDROMAGNETIC TURBULENCE. I. A DEDUCTIVE THEORY. S.Chandrasekhar.
Proc. Roy. Soc. A, Vol. 233, 322-30 (Dec. 29, 1955).

The author's deductive theory of turbulence (Abstr. 4408/1955) is extended to hydromagnetics. By considering stationary turbulence and making statistical hypotheses of the same general character as in the hydrodynamical theory, a pair of differential equations are derived for the scalars defining the isotropic tensors describing the correlation in the velocities and the intensities of the magnetic field at two different points and at two different times.

A.

538.56 : 532.5

3853. HYDROMAGNETIC TURBULENCE. II. AN ELEMENTARY THEORY. S.Chandrasekhar.
Proc. Roy. Soc. A, Vol. 233, 330-50 (Dec. 29, 1955).

An elementary theory of hydromagnetic turbulence is developed along the lines of Heisenberg's theory of ordinary turbulence. The basic physical idea underlying this theory is to conceive the transformation of the kinetic energy at a particular wave-number into kinetic energy and magnetic energy at higher wave-numbers, and similarly, the transformation of the magnetic energy at a given wave-number into kinetic energy and magnetic energy of higher wave-numbers, as a cascade process which can be visualized in terms of suitably defined coefficients of eddy viscosity and eddy resistivity. The resulting equations for the cascade process have been solved under stationary conditions in the limiting case of zero viscosity and infinite electrical conductivity. It is shown that in this limiting case there exist two distinct modes of turbulence; these have been distinguished as the velocity mode and the magnetic mode respectively. In both modes equipartition between the two forms of energy prevail among the largest eddies present (i.e. as $k \to 0$); and the spectrum of both the kinetic energy and the magnetic energy have a Kolmogoroff behaviour for $k \to 0$. The two modes differ in their behaviour for $k \to \infty$. In the velocity mode the ratio of the magnetic energy to the kinetic energy tends to zero

among the smallest eddies present (i.e. as $k \to \infty$), while in the magnetic mode the same ratio tends to about 2.6 as $k \to \infty$. The bearing of these results on the possible character of the interstellar magnetic fields is briefly discussed. A.

538.56 : 532.5

3854. MAGNETO-HYDRODYNAMIC WAVES IN INCOMPRESSIBLE AND COMPRESSIBLE FLUIDS. A.Baños, Jr.
Proc. Roy. Soc. A, Vol. 233, 350-66 (Dec. 29, 1955).

An earlier paper (Abstr. 4777/1955) dealt mainly with the general theory of plane homogeneous waves and of time harmonic cylindrical waves propagating in a homogeneous and isotropic conducting fluid of infinite extent embedded in a uniform field of magnetic induction. The medium is assumed to consist of an ideal fluid devoid of viscosity and expansive friction, which is characterized (in rationalized mks units) by the rigorously constant macroscopic parameters μ, ϵ and σ, where $\mu\epsilon = c^{-2}$ and σ is the (ohmic) conductivity. The present paper deals with the application of the general theory to the determination of the modes of propagation and to the computation of the corresponding propagation constants. It is shown that an incompressible fluid sustains two types of modes: one type devoid of pressure fluctuations (velocity modes), and the other accompanied by pressure oscillations (pressure modes). In the case of cylindrical waves in an incompressible fluid there are two distinct pressure modes, one of which, however, is highly attenuated and therefore of little physical interest. It is found that a compressible fluid also sustains the same class of velocity modes (devoid of pressure fluctuations and hence independent of the velocity of sound in the medium) as an incompressible fluid. In addition, a compressible fluid is shown to propagate two distinct pressure modes which, under appropriate limiting conditions peculiar to each type, behave respectively as a modified sound wave and as a modified magnetohydrodynamic wave. And, for every mode discussed here, there are presented the limiting forms of the propagation constant in three cases of physical interest: infinite conductivity, slightly attenuated modes, and weak magnetohydrodynamic coupling which arises when the externally applied field is vanishingly small. A.

538.56 : 532.5

3855. THE STRUCTURE OF MAGNETO-HYDRODYNAMIC SHOCK WAVES. W.Marshall.
Proc. Roy. Soc. A, Vol. 233, 367-76 (Dec. 29, 1955).

The equations describing the detailed structure of magneto-hydrodynamic shocks are derived and their solutions discussed in the special cases of high or low electrical conductivity. For high conductivity the shock front has a width of several mean free paths. For low conductivity, if the initial magnetic field is smaller than a certain critical value, a sharp shock is preceded by a wide region in which the field, velocity and temperature change slowly; if the field is larger than this critical value, then no sharp shock occurs and all the variables change slowly over a wide region. A small double layer of charge is built up on the shock front as a result of the Hall effect. A.

538.56 : 532.5

3856. WAVES IN A HEAVY, VISCOUS, INCOMPRESSIBLE, ELECTRICALLY CONDUCTING FLUID OF VARIABLE DENSITY, IN THE PRESENCE OF A MAGNETIC FIELD. R.Hide.
Proc. Roy. Soc. A, Vol. 233, 376-96 (Dec. 29, 1955).

The equilibrium of a horizontal layer of a heavy incompressible fluid of variable density ρ_0 in the vertical direction is stable or unstable according as $d\rho_0/dz$ (z being the upward vertical) is everywhere negative or is anywhere positive. In the unstable case, the rate n at which the system departs from equilibrium depends on the total wave-number k of the initial disturbance, and there is, in general, one mode characterized by n_m and k_m which grows more rapidly than any other. In the stable case, after an initial disturbance the equilibrium may be restored either periodically or aperiodically, depending on the value of k. The periodic type of motion gives rise to horizontally propagated "gravity waves". This paper examine the influence of viscosity and hydromagnetic forces on the hydrodynamical motion produced by a small disturbance of th aforementioned equilibrium situation. The appropriate pertur bation theory is developed initially for any density field $\rho_0(z)$ and kinematical viscosity $\nu(z)$ for a fluid of constant electrica conductivity σ e.m.u. and magnetic permeability κ in the presence of a uniform magnetic field of strength H_0 in the direction of gravity, acceleration g. The solution is expresse in the form of integrals, and is shown to be characterized by variational principle. Based on the variational principle an approximate solution is obtained for the special case of a flui of finite depth d stratified according to the law $\rho_0 = \rho_1 \exp(\beta z$ and for which ν is constant. It is shown that if n and k are measured in suitable units, they are related by an equation involving three dimensionless parameters:

$$R = (\eta\pi s/2dV_A), \quad S = (\nu\pi s/2dV_A) \quad \text{and} \quad B = (g\beta d^2/\pi^2 s^2 V^2_A),$$

where $\eta = (4\pi K\sigma)^{-1}$, $V^2_A = (kH_0^2/4\pi\rho_1)$, and s is an integer involved in the description of the velocity field. Explicit solutio may be obtained in three cases, namely, (a) $R \to \infty$, (b) $B = 0$, (c) $R = 0$. Case (a) has been discussed in a previous paper. Other cases will be discussed in a future paper. Only cases (b) and (c) are considered here. In case (b) the problem is of hydromagnetic waves damped by viscosity and electrical resi tance; the properties of these waves are described. Case (c) is limited to an ideal conductor. When $B > 0$ the equilibrium unstable; the influence of viscosity and hydromagnetic forces on the mode of maximum instability is briefly discussed. Whe $B < 0$, the equilibrium is stable. If $-B \leq 2$, $S^2 \geq 1$, or $-B > S^2 \geq (4(1-B)^3/27B^2)$, the equilibrium is always restored aperiodically. Otherwise, waves can be generated, but only when the wavelength lies within a certain range. These waves combine the properties of gravity waves and hydromagnetic waves. A

538.56 : 532.

3857. SOME ENGINEERING APPLICATIONS OF MAGNETO HYDRODYNAMICS. J.A.Shercliff.
Proc. Roy. Soc. A, Vol. 233, 296-401 (Dec. 29, 1955).

The sensitivity of an electromagnetic flowmeter depends on the form of the velocity profile, which is affected by upstream conditions and, when the fluid is a highly conducting liquid metal, by magnetohydrodynamic forces. The steady state of the velocity profile and the distance necessary for it to be reached are predicted and compared with experiment. Other results concern the settling of the motion in a flowmete downstream of an obstruction. A

538.56 : 532.5 : 523.16

3858. ON THE ACCELERATION OF COSMIC-RAY PARTICLES BY MAGNETO-HYDRODYNAMIC WAVES. W.B.Thompson.
Proc. Roy. Soc. A, Vol. 233, 402-6 (Dec. 29, 1955).

The relativistic motion of a charged particle in a variable magnetic field is considered, the field being uniform apart from a small perturbation in the form of a travelling wave. An estimate of the average gain in particle energy shows that an acceleration time as low as 5×10^8 years could be consistent with astrophysical data, and hence that the Fermi theory could give the observed power-law spectrum. R.A.Newin

538.56 : 532.

3859. STRUCTURE OF A MAGNETOHYDRODYNAMIC SHOCK WAVE IN A PLASMA OF INFINITE CONDUCTIVITY. H.K.Sen.
Phys. Rev., Vol. 102, No. 1, 5-11 (April 1, 1956).

The structure of a magnetohydrodynamic perpendicular shock wave (magnetic field perpendicular to the direction of propagation) in a plasma of infinite conductivity has been analysed. For the nonmagnetic case, the width of the shock

front is found to be larger than in a non-ionized gas. Further, the width of the shock (in terms of mean free path within the shock) as a function of the shock strength as determined from the Stokes-Navier equations (which applies to weak shocks) is found to join smoothly at $M \cong 1.3$ with the same function as derived from the Mott-Smith analysis (which applies to strong shocks). The magnetic field tends to make the shock front narrower for shocks of moderate strength. It does not have appreciable effect for strong shocks. Application of the above results to solar radio noise and current theories of the origin of cosmic rays is indicated. A.

538.561

3860. ON A GENERALIZATION OF THE RECIPROCITY THEOREM FOR SOLUTIONS OF THE OSCILLATION EQUATION WITH MULTIPOLE SOURCES. A.Rubinowicz.
Acta phys. Polon., Vol. 14, No. 3, 183-90 (1955). In German.

The theorem of the interchangeability of the coordinates of the source and those of the point at which the field is calculated, in a Green function of the equation $\nabla^2 u + k^2 u = 0$ is extended to the case of two solutions u_1, u_2, each having only one singular point representable by multipoles. A bilinear relation is found to exist between (1) the coefficients representing the strengths and phases of these multipoles at the sources 1 and 2 respectively of u_1 and u_2; and (2) the coefficients of the expansion in spherical and Bessel functions of u_1 and u_2 respectively at the points 2 and 1, where they are regular.

L.Pincherle

538.561 : 621.373.5 : 621.315.59

3861. NOTE ON A PARTICULAR STRUCTURE FOR OBTAINING HIGH-FREQUENCY (ELECTRICAL) OSCILLATIONS. A.Leblond and R.Gentner.
C.R. Acad. Sci. (Paris), Vol. 242, No. 5, 621-3 (Jan. 30, 1956). In French.

Describes a structure consisting of metal/p-type semiconductor/intrinsic semiconductor/metal. At low temperatures for currents in the direction I → P, a negative resistance region is observed. When connected with a parallel capacitance, oscillations at 35 Mc/s may be obtained. C.A.Hogarth

538.561 : 621.385.16.029.6

3862. PLASMA OSCILLATIONS AND RESONANCE FREQUENCIES IN A MAGNETRON IN THE BRILLOUIN REGIME. J.Coste and J.L.Delcroix.
C.R. Acad. Sci. (Paris), Vol. 242, No. 1, 87-90 (Jan. 4, 1956). In French.

By considering the perturbation of a univelocity electron cloud it is shown that the magnetron in the Brillouin regime exhibits a discrete sequence of resonant frequencies proportional to the gyromagnetic resonance frequency but depending on the ratios b/a and c/a, where a = cathode radius, c = anode radius, b = cut-off radius. A.H.W.Beck

538.565

3863. ELECTROMAGNETIC CAVITIES AND THEIR APPLICATIONS IN PHYSICS. T.Kahan.
Mém. Sci. phys., Vol. 60, 120 pp. (1956). In French.

The first four chapters provide a comprehensive review of the physical principles and methods of solution of electromagnetic cavities. In the last chapter the role of the electromagnetic cavity as a tool in modern physical research is described, including its applications in measurements on dielectrics, nuclear moments, and the magnitude of the Lamb–Retherford effect. A.J.Egginton

538.566 : 621.372.8

3864. ON THE RESONANCE FREQUENCIES AND THE FIELD CONFIGURATIONS IN TERMINATED CORRUGATED WAVEGUIDES. V.J.Vanhuyse.
Physica, Vol. 21, No. 10, 829-38 (Oct., 1955).

Approximate frequency equations are obtained for the different resonance modes of circularly symmetric transverse magnetic waves in terminated corrugated waveguides in which the diameters 2b of the cavities may differ, Δb being small with respect to b and b – a (a = radius of iris hole). In the approximation used, the longitudinal electric field component E_z in each corrugation turns out to be a symmetric or an antisymmetric function of the longitudinal coordinate x with respect to the middle of the corrugation. Experiments with 1, 2 and 3 cavities plus two "halves" carried out in the second pass-band and those carried out in the first pass-band are in agreement with this statement. In the first pass-band $E_z(x)$ is an even function of x, in the second band it is odd. For each mode the measured resonance frequencies in systems with diameters $2b_1$, and $2b_2$ can be predicted if the corresponding frequencies in systems containing cavities with a diameter $2b_1$ only and $2b_2$ only are known. A.

538.566

3865. REFLECTION AND TRANSMISSION AT A SLOTTED DIELECTRIC INTERFACE. R.E.Collin.
Canad. J. Phys., Vol. 34, No. 4, 398-411 (April, 1956).

A theoretical analysis of a slotted dielectric interface is given for the case of a plane wave incident at an angle θ_i and polarized with the electric vector parallel to the slots. A variational solution yielding upper and lower bounds to the parameters of the equivalent circuit for the interface is given. A numerical example for a wave incident at an angle of 30^0 on a slotted dielectric with a relative dielectric constant of 2.56 at a wavelength of 3.14 cm shows that the phase shifts introduced into the reflected and transmitted waves are of the order of 1^0. Also the impedance transformation across the interface is just that due to the change in wave impedance. Such a slotted dielectric may be used to match a microwave lens to free space. A theoretical calculation shows that the reflection coefficient does not exceed 5% for angles of incidence up to 30^0 in the wavelength range 3–3.28 cm for a slotted section used to match a dielectric of relative dielectric constant 2.56 to free space. Without a matching section the reflection coefficient is 23% or more. A.

538.566 : 536.2 : 535.42

APPLICATIONS OF THE FOURIER INTEGRALS IN PHYSICAL SCIENCE. See Abstr. 2814

538.566 : 537.311.33 : 538.614

3866. FARADAY EFFECT IN GERMANIUM AT ROOM TEMPERATURE. R.R.Rau and M.E.Caspari.
Phys. Rev., Vol. 100, No. 2, 632-9 (Oct. 15, 1955).

When a plane-polarized electromagnetic wave passes through a semiconductor and a static magnetic field is applied along the direction of propagation, there occurs a rotation of the plane of polarization and the transmitted radiation is found to be elliptically polarized. This effect is due to the influence of the free charge carriers in the semiconductor and has been analysed using the Drude–Zener model. For small losses, weak magnetic fields, and small values of $\omega\tau$ (assuming the relaxation time τ to be energy-independent) the angle of rotation of the plane of polarization can be expressed to a first order of approximation by the simple formula:

$$\theta = \tfrac{1}{2}(\mu_0/\epsilon_0)^{1/2}(\sigma_0 \mu B/\sqrt{K'})t,$$

where μ is the Hall mobility, σ_0 is the d.c. conductivity, B is the magnetic field, t is the thickness of sample traversed, K' is the dielectric constant of the material at the frequency employed in the experiments, and ϵ_0 and μ_0 are the dielectric constant and the permeability of free space respectively. For spherical energy surfaces, the degree of ellipticity, which is a second-order effect, can be expressed by the relation $\mathcal{E} = (\mu_0/\epsilon_0)^{1/2}[\sigma_0(\mu B)(\omega\tau)/\sqrt{K'}]t$ where $\omega/2\pi$ is the frequency and τ is the relaxation time. Thus, for small losses the ellipticity is proportional to the latter quantity. For the case of low frequencies, the effect can be explained by the introduction of a Hall-effect type field into Maxwell's equations. In general, the angle of rotation and the ellipticity

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may depend on the direction of the applied magnetic field because because of the non-spherical nature of the energy surfaces. Room-temperature measurements of the angle of rotation at microwave frequencies on both n- and p-type samples of germanium gave values of 3780 $cm^2/V.sec$ and 3300 $cm^2/V.sec$ for the electron and hole mobilities respectively. The method should be applicable to the determination of mobilities in powdered samples without using electrodes, if the field inside the powdered particles is determined by a Clausius–Mosotti type approximation. A.

538.566 : 537.533.9

3867. INCIDENCE OF AN ELECTROMAGNETIC WAVE ON A "ČERENKOV ELECTRON GAS". M.A.Lampert.
Phys. Rev., Vol. 102, No. 2, 299-304 (April 15, 1956).

An electron gas moving in vacuum, if sufficiently dense, acts like a mirror to an incident electromagnetic wave. A "Cherenkov electron gas", that is, an electron gas moving through or sufficiently close to a slow-wave medium at a velocity exceeding that of an electromagnetic wave in the medium, cannot, in the conventional sense, reflect the wave. A detailed analysis of this problem is presented, and it is shown that above a critical density a Cherenkov electron gas does exhibit a "mirror-like" quality; namely, it does reverse, inside the gas, the direction of propagation of an electromagnetic wave incident upon it. A.

538.566 : 621.371

3868. OBLIQUE INCIDENCE OF A PLANE WAVE ON A WIRE LATTICE. V.G.Yampol'skiĭ.
Radiotekhnika, Vol. 10, No. 9, 39-48 (1955). In Russian.

Exact formulae are obtained for the reflected and transmitted waves from a grid of very thin equispaced parallel wires when a plane wave is obliquely incident. Graphs are plotted of the reflection coefficient as a function of incidence angle for parallel-electric and perpendicular-magnetic vectors for two values of wire thickness and spacing. S.C.Dunn (R)

538.566 : 621.396.11

3869. AN APPROXIMATE THEORY OF THE DIFFRACTION OF AN ELECTROMAGNETIC WAVE BY AN APERTURE IN A PLANE SCREEN. R.F.Millar.
Proc. Instn Elect. Engrs, Monogr. No. 152 R, publ. Oct., 1955 (Vol. 103 C, 177-85).

Republication of the monograph abstracted in Abstr. 507 (1956).

538.566 : 621.396.674.3

3870. TRANSIENT FIELDS OF A VERTICAL DIPOLE OVER A HOMOGENEOUS CURVED GROUND. J.R.Wait.
Canad. J. Phys., Vol. 34, No. 1, 27-35 (Jan., 1956).

Expressions are derived for the transient fields of a short vertical aerial, situated on a smooth spherical conducting earth, and energized by a current which is discontinuous in time. When the aerial current is a linear function of time, the radiation field on a flat perfectly conducting earth is of step-function form. The departure from the step shape of the field is shown to be due to the finite conductivity and dielectric constant of the ground, the induction and static fields of the aerial, and the curvature of the earth. A.

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

3871. TWO-CENTER INTEGRALS FOR IRON USING WAVE FUNCTIONS WITH EXCHANGE. M.Suffczyński.
Nuovo Cimento (Ser. 10), Vol. 2, No. 6, 1320-1 (Dec., 1955).

Gives values of the integrals for b.c.c. Fe usable in a tight-binding calculation, using the method of calculation given by Fletcher and Wohlfarth for Ni. E.P.Wohlfarth

539.11 : 539.32 : 536.71

3872. EQUATION OF STATE AND ELASTICITY OF SOLID ARGON. E.R.Dobbs.
J. chem. Phys., Vol. 24, No. 2, 477-8 (Feb., 1956).

A comment on the Henkel (Abstr. 5548/1955) equation of state. This yields values of the specific heat and compressibility which agree well with experiment, but does not accord with experimental results on the temperature-variation of the density and longitudinal velocity of sound. It is though unlikely that a two-constant interatomic potential (as used by Henkel) can provide an adequate basis for a general theory.

A.J.Kennedy

539.11 : 539.15/.18 : 530.145

THEORETICAL PHYSICS. See Abstr. 2636

539.11 : 537.311.32

3873. ELECTRONIC PROPERTIES OF AROMATIC HYDROCARBONS. I. ELECTRICAL CONDUCTIVITY. D.C.Northrop and O.Simpson.
Proc. Roy. Soc. A, Vol. 234, 124-35 (Jan. 24, 1956).

An account is given of an experimental study of the conductivity of pure aromatic hydrocarbons, and of solid solutions in which one hydrocarbon is introduced into another as an impurity. A method is described for preparing evaporated films of solid solutions with a known concentration of impurity. They are suitable for electrical or optical measurements. From the temperature-dependence of conductivity of a characteristic activation energy can be derived for each pure compound; this is equal to, or greater than, the triplet state energy of the free molecules. The conductivity of a solid solution is greater than that of the pure solvent, and has an activation energy which is characteristic of the solute only. The activation energies of impurities are approximately equal to the calculated triplet state energies of the free molecules, where such data exist. In the one case where comparison can be made with an experimental phosphorescence energy the agreement is excellent. A mechanism of conduction is proposed from a consideration of the electronic excited states of a hydrocarbon crystal. A

539.11 : 535.371

3874. ELECTRONIC PROPERTIES OF AROMATIC HYDROCARBONS. II. FLUORESCENCE TRANSFER IN SOLID SOLUTIONS. D.C.Northrop and O.Simpson.
Proc. Roy. Soc. A, Vol. 234, 136-49 (Jan. 24, 1956).

The fluorescence of solid solutions of aromatic hydrocarbons has been investigated with the object of studying the transfer of excitation energy from solvent to impurity. Anthracene and pyrene were used as solvents, and the solutes comprised nine larger condensed hydrocarbons The concentration ranged from 10^{-5} to 10^{-1} M. Fluorescence spectra were observed by photographic spectrophotometry, and the degree of quenching and quantum efficiency of the transfer process were obtained by comparison with the pure solvent. The dependence of quenching on concentration of impurity may be deduced from a simple theory of exciton migration. The experimental results are in good agreement with this model. The efficiency of a particular impurity species in capturing the excitation cannot be predicted on any simple basis, but there is some evidence that it depends on the symmetry properties of the excited states of solvent and impurity. It is not directly determined by the overlap of solvent emission and impurity absorption, as is the case with sensitized fluorescence. A.

MOLECULES 539.13

539.13

3875. INTERACTIONS BETWEEN SYMMETRIC POLYATOMIC MOLECULES. R.Balescu.
Physica, Vol. 22, No. 3, 224-30 (March, 1956).

The interaction of symmetric polyatomic molecules is expanded as a series in Legendre polynomials. It is shown that, owing to the geometric symmetry of the molecules, the relative importance of the non-central forces decreases when one considers successively homonuclear diatomic molecules, tetrahedra and octahedra. These forces make only a small contribution to the total interactions between globular molecules; on the other hand, the central-type interactions are rather strongly modified with respect to a "6–12" potential. Several properties of globular substances are discussed in terms of this modified potential. A.

539.132

3876. ON THE COMPUTATION OF AUXILIARY FUNCTIONS FOR TWO-CENTER INTEGRALS BY MEANS OF A HIGH-SPEED COMPUTER. F.J.Corbató.
J. chem. Phys., Vol. 24, No. 2, 452-3 (Feb., 1956).

With the view of computing simple two-centre integrals by means of a high-speed computer, programmes for certain basic auxiliary functions, which are essentially the usual $A_n(y)$ and $B_n(x)$, have been prepared. Computational procedures for generating these functions are given. A.

539.132

3877. ON BADGER'S RULE. Y.P.Varshni and S.S.Mitra.
Indian J. theor. Phys., Vol. 2, No. 4, 179-84 (Jan., 1955).

A semi-theoretical justification of Badger's rule viz. $K_e(r_e-d)^3 = C$ has been given on a classical model of diatomic molecule. The constant C of a molecule PQ has been shwon to be related with the similar constants of molecules PP and QQ. A.

539.132

3878. ON THE COUPLING BETWEEN ELECTRONIC AND NUCLEAR MOTION AND VAN DER WAALS' INTERACTION BETWEEN HELIUM ATOMS. T.-Y.Wu.
J. chem. Phys., Vol. 24, No.2, 444-6 (Feb., 1956).

The analytical expression for the potential due to the coupling between the electronic and the nuclear motion for two normal helium atoms has been obtained for a wave function of the form of that of P. Rosen. This coupling interaction is a repulsive potential and is to be added to the usual "valence" and Van der Waals' potential obtained in the static-nuclei approximation. This coupling interaction, being inversely proportional to the reduced mass of the two interacting atoms, contributes to a weaker binding between two He^3 atoms than between two He^4 atoms. A.

539.132

3879. DISSOCIATION ENERGY OF GASEOUS LaO.
W.A.Chupka, M.G.Inghram and R.F.Porter.
J. chem. Phys., Vol. 24, No. 4, 792-6 (April, 1956).

The gaseous species in thermodynamic equilibrium with La(l) – La_2O_3(s) mixtures in the temperature range 1650°K to 1900°K have been studied mass spectrometrically. The major ions observed were La^+ and LaO^+. These ions were shown to be formed predominantly from La(g) and LaO(g), respectively. A thermodynamic treatment of ion currents yields a value of $\Delta H_0^\circ = 100 \pm 4$ kcal/g atom for the heat of vaporization of La(s) and a value of $\Delta H_0^\circ = 189 \pm 8$ kcal/mole for the reaction LaO(g) = La(g) + O(g) or D_0(LaO) = 8.15 ± 0.35 eV. A.

539.132

3880. STRETCHING FORCE CONSTANT OF THE CARBONYL BOND IN UNCONJUGATED KETONES. J.O.Halford.
J. chem. Phys., Vol. 24, No. 4, 830-3 (April, 1956).

The secular equation derived for the normal frequencies of a Y-shaped C_2CO model can be used with fair accuracy to obtain the carbonyl bond force constant from the measured carbonyl frequency of any symmetrical ketone if the carbon-carbon force constant and the bond angles are known or can be reasonably assigned. The narrow spread of carbonyl frequencies observed for unconjugated ketones, with assumed "normal" angles and carbon-carbon force constant, indicates a nearly constant carbonyl stretching force constant in the range 10.2 ± 0.3 (x 10^5 dynes/cm). This value should be equally reliable for unsymmetrical unconjugated ketones. In formaldehyde, the calculated force constant is usually above 12.5 units. A.

539.132

3881. A SIMPLE MODEL FOR BARRIERS TO INTERNAL ROTATION. E.A.Mason and M.M.Kreevoy.
J. Amer. Chem. Soc., Vol. 77, No. 22, 5808-14 (Nov. 20, 1955).

A number of symmetrical barriers to internal rotation about single bonds in molecules have been calculated on the assumption that the barriers were caused by ordinary van der Waals repulsions between non-bonded atoms or groups of atoms in the molecules. The repulsions have been estimated by analogy with known repulsions between similar atoms or groups of atoms which are not part of a larger molecule, with allowances made for any residual electrical charges on the atoms or groups. The calculations based on this simplified model indicate that in most cases about half the barrier can be attributed to van der Waals repulsion forces. It is suggested that the remainder can perhaps be explained on the basis of the electrostatic interactions between the charge distributions of the chemical bonds, as originally suggested by Lassettre and Dean and by Oosterhoff. Although it is admittedly rather empirical, the model seems capable of furnishing reasonable estimates of steric repulsions. A.

539.132

3882. THEORY OF INTERNAL OVER-ALL ROTATIONAL INTERACTIONS. II. HAMILTONIAN FOR THE NONRIGID INTERNAL ROTOR. D.Kivelson.
J. chem. Phys., Vol. 23, No. 12, 2230-5 (Dec., 1955).

For Pt I, see Abstr. 424 (1955). An approximate Hamiltonian for a nonrigid internal rotor has been derived. The potential energy has been expanded in a Taylor's series in the displacement coordinates and in a Fourier series in the angle of internal rotation θ. The Hamiltonian was transformed by a contact transformation, and a second-order Hamiltonian in which vibrations and rotations have been separated has been obtained. The Hamiltonian consists of terms which constitute the usual rigid internal rotational problem, of centrifugal distortion terms involving both over-all and internal angular momentum, and of terms that arise because of the repulsive nature of the barrier. These repulsive terms enter as a single term, $2JF_V(m|1 - \cos 3\theta|m)$, in the expression for the rotational transitions of symmetric rotors, where J is the total angular momentum quantum number and m is the pseudo-quantum number for internal rotation. The repulsive constant, F_V, is given by the relation

$$F_V = -\Sigma \tfrac{1}{2}[B_{xx}^{(i)} + B_{yy}^{(i)}]a_i^{(1)},$$

where $B_{xx}^{(i)} + B_{yy}^{(i)}$ is the derivative of the rigid rotor rotational constant with respect to the ith symmetry coordinate, and $a_i^{(1)}$ is one-half the displacement of the equilibrium position of the ith internal coordinate in going from $\theta = 0$ to $\theta = \pi/3$. The dependence of the barrier height upon the vibrational motion has also been studied. A.

539.132

3883. THEORY OF INTERNAL OVER-ALL ROTATIONAL INTERACTIONS. III. NONRIGID ASYMMETRIC ROTORS. D.Kivelson.
J. chem. Phys., Vol. 23, No. 12, 2236-43 (Dec., 1955).

The theory of the interactions of hindered internal rotation with over-all rotations is extended to include nonrigid asymmetric rotors. The interdependence of hindered internal rotation and vibrations and their effect upon the vibrational energy

levels is considered. The theory is developed analogously to the theory developed previously for symmetric rotors. An approximate over-all internal rotational wave-function of the form $1/(2\pi)^{1/2} \exp[i(P_z Iz_z/Iz - \tau)]\Phi_\tau$ is discussed, where Φ_τ is the wave-function that diagonalizes the rigid rotor Hamiltonian and τ is an integer. While the general energy relation involves too many parameters to compute or to fit empirically, certain special cases are discussed. In particular for the $0_{00} \rightarrow 1_{01}$ transition of the CH_3NO_2 type of molecule one has

$$\nu(0_{00} \rightarrow 1_{01}) = (1_{01}|\langle H\rangle_R|1_{01})[1 + F_1(m|1 - \cos 3\theta|m)] + G_3(m|\Pi^2|m) + 2G_3(m|\Pi^2|m) + 2F_2(m|1 - \cos 3\theta|m),$$

where $(1_{01}|\langle H\rangle_R|1_{01})$ is the rigid rotor energy for the 1_{01} level, θ is the angle of internal rotation, Π is the internal angular momentum, m indicates a given internal rotational level, and the F's and G's are constants which can be evaluated from a knowledge of the vibrational characteristics of the molecule and of the forces that constitute the hindering barrier to internal rotation. A.

539.132

3884. FIRST-ORDER DEACTIVATION OF EXCITED β-NAPHTHYLAMINE MOLECULES WITH LOW VIBRATIONAL ENERGY RESERVE. B.Stevens.
J. chem. Phys., Vol. 24, No. 2, 488-9 (Feb., 1956).

Discusses the results of Boudart and Dubois (Abstr. 2964/55). The vibrational heat capacity calculated from the horizontal displacement of curves in the log d/T^{-1} plots [d is the probability of radiation-less transition] is close to the theoretical value; when used for calculating the vibrational temperature of excited molecules it gives less scatter of the low-energy data. The two band groups (3515-3289 and 2871-2611 A) in the near ultraviolet spectrum of β-naphthylamine vapour are probably associated with different electronic transitions. Mechanisms of radiation-less transitions are suggested. F.Lachman

539.132

3885. MOLECULAR CONSTANTS OF NITROUS OXIDE FROM MEASUREMENTS OF ν_2 AT 17 μ. K.Lakshmi, K.Narahari Rao and H.H.Nielsen.
J. chem. Phys., Vol. 24, No. 4, 811-13 (April, 1956).

The vibration-rotation absorption band of nitrous oxide associated with the fundamental bending vibration ν_2 at 17 μ was measured with a grating ruled with 2000 lines/in. and the molecular constants were determined. It was not possible to detect any change in the centrifugal stretching constants for the two states involved in the transition. A.

539.132

3886. THE STUDY OF ENERGY TRANSFER BY KINETIC SPECTROSCOPY. I. THE PRODUCTION OF VIBRATIONALLY EXCITED OXYGEN. F.J.Lipscomb, R.G.W.Norrish and B.A.Thrush.
Proc. Roy. Soc. A, Vol. 233, 455-64 (Jan. 10, 1956).

The flash photolysis of chlorine dioxide or of nitrogen oxide in a great excess of inert gas yields oxygen molecules in their electronic ground states with up to eight quanta of vibrational energy. By a study of the reaction kinetics of the two systems, it is concluded that these excited molecules have their origin in the reactions: $O + NO_2 = NO + O_2^*$ and $O + ClO_2 = ClO + O_2^*$ respectively. Thus, for the first time there becomes available a very convenient method of studying the collisional transfer and degradation of vibrational energy from molecules in the higher vibrational levels of the ground state and some preliminary measurements of the efficiency of deactivation by various molecules are given. It is concluded that the energy is removed most readily either when there is near resonance of the vibrational levels with those of the oxygen, or by free radicals. Some of the reactions of the chlorine oxides present are also discussed. A.

539.132 : 539.133

3887. CORRELATION OF INFRARED STRETCHING FREQUENCIES AND HYDROGEN BOND DISTANCES IN CRYSTALS. G.C.Pimentel and C.H.Sederholm.
J. chem. Phys., Vol. 24, No. 4, 639-41 (April, 1956).

Empirical correlations between X—H...Y distance R and frequency shift of the X—H stretching motion $\Delta\nu$ are presented for O—H...O, N—H...O and N—H...N hydrogen bonds. A linear correlation is possible provided a distinct straight line is assumed for each hydrogen bond type. The equations of the best straight lines and standard deviations are:

O—H...O $\Delta\nu(cm^{-1}) = 4.43 \times 10^3 (2.84\text{-}R)$ $\sigma(\Delta\nu) = 199\ cm^{-1}$
N—H...O $\Delta\nu(cm^{-1}) = 0.548 \times 10^3 (3.21\text{-}R)$ $\sigma(\Delta\nu) = 24\ cm^{-1}$
N—H...N $\Delta\nu(cm^{-1}) = 1.05 \times 10^3 (3.38\text{-}R)$? A.

539.132

3888. ELECTRONIC AND VIBRATIONAL STATES OF AZULENE. J.W.Sidman and D.S.McClure.
J. chem. Phys., Vol. 24, No. 4, 757-63 (April, 1956).

The absorption and emission spectra of azulene have been studied in a substitutional solid solution in naphthalene at 20°K. The spectra are polarized and are very sharp, and from the polarization properties of the absorption transitions it has been determined that the first excited state at 14 652 cm^{-1} is L_b, $^1B_1$ (an electronic state being designated by giving first the Platt symbol and then the C_{2v} group symbol) (the transition with the ground state is transversally polarized), whereas the second excited state at 28 050 cm^{-1} is L_a, $^1A_1$ (the transition with the ground state is long-axis polarized), in agreement with the theoretical predictions of Platt and Moffitt. Vibrational analyses have been performed for the two absorption transitions, and the second transition appears to be perturbed by vibrational-electronic interaction. A sensitized emission spectrum has also been found, in which excitation of the naphthalene leads to emission from the second excited state of azulene to the ground state. A vibrational analysis of the emission transition yields ground state vibrational frequencies which are in excellent agreement with the vibrations deduced from the infrared absorption spectrum. Environmental effects are discussed, and an attempt is made to correlate the vibrations in the different electronic states. A.

539.132

3889. ELECTRONIC SPECTRA OF CYCLO-OCTATETRAENE, TETRAPHENYLENE, AND s-DIBENZCYCLO-OCTATETRAENE. K.L.McEwen and H.C.Longuet-Higgins.
J. chem. Phys., Vol. 24, No. 4, 771-6 (April, 1956).

The electronic transition energies of cyclo-octatetraene, tetraphenylene and s-dibenzcyclo-octatetraene are calculated by treating each molecule as four separate π-electron subsystems, the excited configurations of which interact under the influence of the Hamiltonian for the complete system. The calculated transition energies for cyclo-octatetraene and tetraphenylene are in good agreement with experimental data, while the calculations for s-dibenzcyclo-octatetraene suggest that the absorption data for this compound is in error. A.

539.132

3890. EXACT WAVE FUNCTIONS OF HeH^{2+}. D.R.Bates and T.R.Carson.
Proc. Roy. Soc. A, Vol. 234, 207-17 (Feb. 7, 1956).

The 1sσ, 2sσ, 2pσ, 2pπ and 3dσ states of HeH^{2+} are investigated. The main results are given in the form of tables from which the exact wave-functions can be obtained. A set of figures showing the behaviour in going from the united atom limit to the separated atoms limit is also presented. The 2pσ state is bound; for it the equilibrium internuclear separation is 2.05_0 A and the dissociation energy is 0.849_0 eV. A.

539.132

3891. PROTON-DEUTERON HYPERFINE STRUCTURE IN PARAMAGNETIC RESONANCE: A π - σ INTERACTION. B.Venkataraman and G.K.Fraenkel.
J. chem. Phys., Vol. 24, No. 4, 737-40 (April, 1956).

The mechanism of the hyperfine splitting observed in para-

magnetic resonance spectra of certain aromatic free radicals containing protons adjacent to the aromatic ring is examined. It is shown that the magnitude of the interaction between an unpaired electron in a π orbital and a vibrating hydrogen atom is insufficient to account for the observed splitting. Such a vibrational mechanism is considered to be untenable: (i) on the basis of quantitative calculations, (ii) by the failure to observe lines corresponding to the first excited vibrational state, and (iii) by a comparison of the splitting caused by protons and deuterons. It is suggested that the unpaired electron is not in a purely π state and that the splitting may be accounted for by configuration interaction between π and σ states. A.

539.132

3892. INDIRECT HYPERFINE INTERACTIONS IN THE PARAMAGNETIC RESONANCE SPECTRA OF AROMATIC FREE RADICALS. H.M.McConnell.
J. chem. Phys., Vol. 24, No. 4, 764-6 (April, 1956).

It is shown that an electron spin polarization associated with an odd electron in a π-molecular orbital in an aromatic free radical can, through an atomic exchange coupling mechanism, produce an appreciable resultant electron spin polarization in s-atomic orbitals at the aromatic protons. This resultant spin polarization gives rise to hyperfine interactions with aromatic protons which are of the same order of magnitude as those observed in the paramagnetic resonance spectra of aromatic free radicals. An equation is developed which relates (proton-spin)-(electron-spin) hyperfine coupling constants to the π distribution of the odd electron in the aromatic free radicals. A.

539.132

3893. A THEORETICAL ANALYSIS OF THE MAGNETIC HYPERFINE STRUCTURE OF THE MICROWAVE SPECTRUM OF C_{2v} MOLECULES. A.Okaya.
J. Phys. Soc. Japan, Vol. 11, No. 3, 249-58 (March, 1956).

A theoretical analysis of magnetic hyperfine structure due to the magnetic interaction between the spins of off- or on-axis nuclei and the molecular rotational magnetic field is developed for asymmetric C_{2v} molecules in ^1A electronic and vibrational ground state. This analysis is for the special case where two equivalent nuclei of spin 1/2 are off the molecular axis, one nucleus of spin zero and one nucleus of arbitrary spin are on the molecular axis. It predicts that a triplet will be observed for prolate rotational transitions for which $\Delta J = 0$, $\Delta K_{+1} = -1$, and both initial and final K_{-1} values are odd. A.

539.132 : 541.127

3894. MEASUREMENT OF THE RATE OF AN ELECTRON EXCHANGE REACTION BY NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY. C.R. Bruce, R.E.Norberg and H.I.Weissman.
J. chem. Phys., Vol. 24, No. 2, 473-5 (Feb., 1956).

The addition of its one electron oxidation product, Wurster's blue, to N,N,N',N' tetramethyl-p-phenylene-diamine broadens the proton resonance lines in D_2O solution up to 7 milligauss. The broadening is proportional to the Wurster's blue concentration and is due to an electron exchange reaction with a rate constant = 2.5×10^4 litre.mole^{-1} sec^{-1}. D.H.Whiffen

539.132

3895. ON THE REPRESENTATIONS, CALCULATION AND INDEFINITE CORRECTION OF THE ERROR IN THEORETICAL CHEMISTRY. III. A.Laforgue.
Cahiers de Phys., No. 63, 18-34 (Nov., 1955). In French.

For Pt II, see Abstr. 534 (1956). A general discussion of representing the error by a potential which seems preferable to the representation in Pt I. It is shown that the fictitious problem, of which an approximate function is a solution, differs from the real problem through the introduction of the error potential. J.Jacobs

539.132

3896. ON THE REPRESENTATIONS, CALCULATION AND INDEFINITE CORRECTION OF THE ERROR IN THEORETICAL CHEMISTRY. IV. A.Laforgue.
Cahiers de Phys., No. 64, 11-31 (Dec., 1955). In French.

An application of the idea of error potential. To each molecular orbital process is attached a new one, based on a change of effective nuclear charge; this gives an expression for the perturbation in a configuration provided one seeks to correct a local error. The question of polarizability and of the choice of effective parameters is also discussed. J.Jacobs

539.132

3897. ELECTRONIC POPULATION ANALYSIS ON LCAO—MO MOLECULAR WAVE FUNCTIONS. III. EFFECTS OF HYBRIDIZATION ON OVERLAP AND GROSS AO POPULATIONS. R.S.Mulliken.
J. chem. Phys., Vol. 23, No. 12, 2338-42 (Dec., 1955).

For Pt II, see Abstr. 3075 (1956). The effects of AO hybridization on gross AO and overlap populations for LCAO—MO electron configurations are discussed in terms of some simple examples, using equations and graphs. The validity of "gross AO populations" as true measures of the population in various AOs is critically discussed. It is shown that the degree of hybridization in the AOs of an LCAO MO does not in general give the true amount of s or p character in the MO; this is given instead by the gross s or p population in the MO. Nevertheless, "forced hybridization" among the AOs, although not contributing to gross AO populations, leads to important negative contributions to overlap populations, hence to bond energies. For example, forced 2s-2p hybridization has the result that the total overlap population for two pairs of electrons occupying bonding σ LCAO MOs built from 2s and 2pσ AOs in a homopolar diatomic molecule is actually less than the sum of the overlap populations which one would have if one pair could be in an MO built from pure 2s AOs and the other in an MO built from pure 2pσ AOs. This sort of forced hybridization with resultant loss of bond strength may explain why double bonds seldom if ever consist of two σ bonds. A.

539.132

3898. ELECTRONIC POPULATION ANALYSIS ON LCAO—MO MOLECULAR WAVE FUNCTIONS. IV. BONDING AND ANTIBONDING IN LCAO AND VALENCE-BOND THEORIES. R.S.Mulliken.
J. chem. Phys., Vol. 23, No. 12, 2343-6 (Dec., 1955).

It is shown that there is a practically one-to-one correspondence between the occurrence, on the one hand, of positive (bonding) and negative (antibonding) overlap populations in LCAO theory and, on the other hand, of bonded attractions and nonbonded repulsions in VB (valence-bond) theory. This correspondence is discussed in terms of examples, and is traced for the N_2 molecule both for the assumed case of no s-p hybridization, and for the actual case with hybridization. It is pointed out that repulsions between nonbonded atoms in VB theory (including those which give rise to steric hindrance) have their counterpart in negative overlap populations between the same atoms in LCAO theory. The π overlap populations for the various links in 1,3-butadiene are computed by LCAO theory. It is shown how they are affected by conjugation and the results are compared with those of VB theory. A.

539.132

3899. MOLECULES WITH TETRAHEDRAL AND OCTAHEDRAL SYMMETRY. IV. A MODIFIED THOMAS—FERMI SCHEME FOR MOLECULES WITH HEAVY ATOMS IN THE OUTER POSITIONS. C.A.Coulson and N.H.March.
Proc. Cambridge Phil. Soc., Vol. 52, Pt 1, 114-18 (1956).

For Pt III, see Abstr. 7237 (1955). In Pt I of this series it was shown that for CCl_4 the approximation of smoothing out the Cl nuclei over the surface of a sphere did not lead to reasonable results for the Thomas—Fermi distribution of electrons in the molecule. An alternative method in which the

inner-shell Cl electrons were first compressed into the nuclei was not theoretically satisfactory because of the neglect of the exclusion principle. In this paper therefore a general scheme is presented in which the inner-shell electrons of the outer atoms are described wave mechanically, assuming them to be undisturbed by molecular binding, but a Thomas–Fermi description is still used for the valence electrons. A method by means of which the exclusion principle can be imposed is formulated. The following paper of the series deals with the application of the method described here to obtain an improved valence electron distribution in CCl_4. A.

539.132

3900. INEQUALITIES FOR MOLECULAR INTEGRALS. A.Weinmann.
Proc. Phys. Soc. A, Vol. 68, Pt 12, 1197-9 (Dec., 1955).

General equations for upper bounds are given for molecular integrals, other than simple overlap ones. A numerical example gives the result for a two-centre exchange integral with four 1-s wave-functions. J.Jacobs

539.132

3901. INVESTIGATIONS INTO THE DISTRIBUTION OF THE ELECTRON DENSITY IN MOLECULES. I. EFFECT OF CHEMICAL BONDS. M.Roux, S.Besnainou and R.Daudel.
J. Chim. phys., Vol. 53, No. 2, 218-21 (Feb., 1956). In French.

A characteristic function is introduced, representing the effect of the chemical bond, which will explain both the density maxima and minima connected respectively with weak and strong bonds. C.Turner

539.132 : 541.57

3902. ELECTRONEGATIVITIES AND BOND ENERGIES. R.T.Sanderson.
J. chem. Phys., Vol. 24, No. 1, 166-7 (Jan., 1956).

Theoretical. The covalent bond energy, E_C kcal/mole, of a non-polar diatomic molecule is related to the electronegativity X, measured by stability ratio (Abstr. 3088/1952), and to R, the sum of the non-polar covalent radii in A, by $E_C = a(X+c)/R - b$. The constants a, b and c for a single bond are 11.8, 5.6 and 5.5; for Group VI elements a and b are 17.8 and 8.4, and for N_2 and CO, a and b are 35.4 and 16.8. Slightly polar diatomic molecules can be handled similarly, with an electrostatic correction. Agreement with experiment for molecules of Groups I, VI, VII, except H_2, F_2 is reasonable. J.Hawgood

539.133 : 536.7

STATISTICAL THERMODYNAMICS OF SEMI-FLEXIBLE CHAIN MOLECULES. See Abstr. 2842

539.133

3903. MATRIX ELEMENTS OF ELECTRONIC TRANSITIONS IN THE H_2^+ HYDROGEN MOLECULAR ION. R.Herman and R.F.Wallis.
Astrophys. J., Vol. 123, No. 2, 353-62 (March, 1956).

The matrix elements of the electric dipole moment for transitions between bound electronic states of the H_2^+ molecular ion for any fixed internuclear separation have been obtained in analytical form, using the Hylleraas solution for the wave functions. As an example, oscillator strengths have been calculated for the $1s\sigma$-$2p\sigma$ and $1s\sigma$-$2p\pi$ transitions at $r_{ab} = 3.00$ a.u. The results 0.2858 and 0.4782, respectively, agree with the previous results of Bates and co-workers to within the accuracy claimed for their numerical integrations. A.

539.133

3904. DIPOLE MOMENT OF NF_3. M.Mashima.
J. chem. Phys., Vol. 24, No. 2, 489 (Feb., 1956).

The small observed moment, 0.234 D, may be explained entirely by 2s–2p hybridization of the N and F AO's in a VB approach. The N hybrids are those corresponding to the bond angles (17.4% s), and the F hybrid with 53.6% s then gives a moment 0.236 D with N^+F^- polarity. Pure s and pure p F hybrids both predict large moments of N^-F^+ polarity. J.Hawgoo

539.133

3905. INFRARED FREQUENCY SHIFTS AND AMIDE GROUP INTERACTIONS. C.G.Cannon.
J. chem. Phys., Vol. 24, No. 2, 491-2 (Feb., 1956).

Proposes an alternative explanation for C=O frequency shifts in polypeptides to that of Krimm (Abstr. 8980/1955), who explained them by intermolecular H-bonding. Comparison of CONH and COOH groups shows that dipole–dipole interaction is a more likely explanation of the shifts. J.Hawgoo

539.133

3906. MICROWAVE DETERMINATION OF THE STRUCTUR OF PYRROLE. B.Bak, D.Christensen, L.Hansen and J.Rastrup-Andersen.
J. chem. Phys., Vol. 24, No. 4, 720-5 (April, 1956).

A number of deuterated pyrroles have been prepared and their microwave spectra recorded. For each isotopic species the two $1 \rightarrow 2$ transitions observable around 20 000 Mc/s were localized together with a number of Q-lines in the 17 400–26 0 Mc/s region scanned. For all isotopic molecules rotational constants were calculated. In this way seven mutually independent numerical data were obtained which is insufficient for a direct ca culation of the nine geometrical parameters of pyrrole. Additiona assumptions as to the length of the two C, H bonds lead to definite models for pyrrole. A

539.133

3907. CONTRIBUTION BY INFRARED SPECTROGRAPHY, TO THE STUDY OF THE MOLECULAR STRUCTURE OF ORDINARY TARTAR EMETIC AND OF SOME ANTIMONY- AND BISMUTH TARTARIC DERIVATIVES. M.Girard and J.Lecomte.
J. Phys. Radium, Vol. 17, No. 1, 9-15 (Jan., 1956). In French.

Diagrams show absorption peaks in the range 700-1700 cr of several powdered tartrates and Bi and Sb tartrates in various stages of dehydration. Although the constitution of tartar emetic is not yet settled, the spectra indicate (1) abser of carbonyl and carboxyl groups (2) presence of one and prob- ably two ionized carboxyl groups (3) one of these latter does not possess the same structure as in metallic salts. G.F.Lothian

539.13

3908. MOLECULAR STRUCTURE OF METHYLAMINE. T.Itoh.
J. Phys. Soc. Japan, Vol. 11, No. 3, 264-71 (March, 1956).

The matrix elements of the Hamiltonian of a semiasymmetric internal rotor which have been given by Hecht and Dennison are rederived in a different way and in a form which is also applicable to more general semiasymmetric internal rotors. This theory together with a semiempirical formula for the inversion splitting is applied to the analysis of the microwave spectrum of methylamine. The barrier height of internal rotation is determined to be 691.1 cm^{-1}. The moment and product of inertia are obtained as A = 37.085, B = 38.662, C = 8.136, C_1 = 2.805, C_2 = 5.331, D = −0.120 all times 10^{-40} $g.cm^2$. The hypothetical inversion splitting in the absence of the coupling between inversion and internal rotation is determined to be 28604 Mc/s for n = 0 and 29358 Mc/s for n = The molecular dimensions are obtained from the inertial constants as follows: d_{CH} = 1.093 A (assumed), d_{NH} = 1.014 A (assumed), d_{CN} = 1.474 A, ∠HCH = 109°30', ∠HNH = 105°50' ∠CNH = 112°10', and the methyl axis passes through the NH_2 triangle making an angle of 3°30' with the CN direction. A

539.133

3909. STATISTICAL COMPUTATION OF MEAN DIMENSIONS OF MACROMOLECULES. III. F.T.Wall, L.A.Hiller, J

nd W.F.Atchison.
. chem. Phys., Vol. 23, No. 12, 2314-21 (Dec., 1955).
For Pt II, see Abstr. 6375 (1955). Random walks subject o the excluded volume effect have been generated by means of high-speed electronic digital computer for a number of ifferent three-dimensional lattices and for one four-dimen-ional lattice. In contrast to results obtained for two-dimen-ional lattices discussed in Pt II, the present results are com-atible with the view that the ratio, $\langle r_n^2 \rangle_{Av}/n$, where $\langle r_n^2 \rangle_{Av}$ s the mean square length of permissible walks of n steps, onverges as $n \to \infty$ for three-dimensional and four-dimensional attices. This conclusion is obtained through an analysis of an ppropriate difference equation employing the methods develop-d earlier. Convergence to a limiting value of the critical atio mentioned above appears relatively rapid for the four-imensional lattice investigated. Possible convergence for he three-dimensional lattices that have been investigated to ate appears to be very slow. Thus, it appears that the limit-ng behaviour will not be approached experimentally for values f n within the usual range of the degrees of polymerization of eal polymer molecules. A.

539.133

910. DETERMINATION OF THE END-TO-END DISTANCE OF HIGH POLYMER MOLECULE IN SOLUTION. H.Mizutani. . Phys. Soc. Japan, Vol. 11, No. 3, 245-48 (March, 1956).
Two convenient methods have been developed for calcula-ing the end-to-end distance of a high-polymer molecule in olution from the intrinsic viscosity and the angular distribution f the intensity of the scattered light, in which the volume-xclusion effect of the chain elements of the molecule and the ffect of the interaction between chain elements and solvent olecules are taken into consideration. By making use of one f these methods, determinations of the end-to-end distances f several kinds of polystyrenes in their solutions have been ade. A.

ATOMS. NUCLEUS. ISOTOPES 539.15

539.15/.18 : 539.11 : 530.145

THEORETICAL PHYSICS. See Abstr. 2636

539.152.1 : 539.16.08

911. NUCLEAR PHYSICS AND ELECTRONICS. M.Fiehrer.
Onde élect., Vol. 35, 981-4 (Nov., 1955). In French.
A general appraisal of electronic instrumentation in uclear research. A typical experiment, on quadrupole inter-ction in Cd^{111}, is outlined to illustrate methods and desirata. T.H.D.Attewell

539.152.1

912. THE α-PARTICLE MODEL OF ^{20}Ne. A.Gamba and .Moncassoli.
Nuovo Cimento (Ser. 10), Vol. 2, No. 5, 1119-20 (Nov., 1955).
The α-particles are arranged at the vertices of a trigonal ipyramid, but in order to get better agreement with experi-ental data, no assumption is made about the equality of all bond distances" between α-particles. By using experimental ata to derive the bond distances, it was found that to obtain he best fit, two α-particles at the vertices of the base triangle re separated by about twice the α-particle radius, while the wo at the vertices of the pyramids are separated only by the -particle radius approximately. Predictions are made about he spins and parities of the 2nd, 3rd and 4th excited states of Ne^{20}. J.Hughes

539.152.1

913. NUCLEON-CORE POLARIZATION IN THE CALCULA-TION OF THE STRENGTH FUNCTION. E.Vogt.
Phys. Rev., Vol. 101, No. 6, 1792-8 (March 15, 1956).
The model of Lane, Thomas and Wigner, for the excited states of nuclei, is generalized by the introduction of a variable amount of nucleon-core polarization into the states of the independent-particle model. The mixing of each of the polarized states, by configuration interaction, into a small neighbourhood near the initial energy of the state forms the basis of the model. The energy moments of the strength function are calculated. The second moment of the strength function, which may be roughly equal to the square of the full width at half-maximum of the strength function, is calculated approximately using a two-body Yukawa potential without exchange. By the choice of a suitable amount of core polarization the large value obtained by Lane, Thomas, and Wigner for the second moment $[(22\ \text{MeV})^2]$ is reduced by a factor of 23 to the reasonably small value of $(4.8\ \text{MeV})^2$. A.

539.152.1

3914. NEUTRON AND PROTON DENSITIES IN NUCLEI. L.Wilets.
Phys. Rev., Vol. 101, No. 6, 1805-9 (March 15, 1956).
A semiempirical investigation of neutron and proton densities in nuclei is made. Experimental values are assumed for the nuclear radius, binding energy, surface energy, surface thickness, and symmetry energy. It is found that the neutron and proton densities extend to approximately the same radius; these results do not depend sensitively on the input data. The nuclear potential extends $\sim 0.7 \times 10^{-13}$ cm further than the material radius. An estimate of ≤ 100 A MeV is given for nuclear compressibility. A.

539.152.1 : 539.172.13

ENERGY DEPENDENCE OF THE OPTICAL MODEL PARAMETERS. See Abstr. 3210

539.152.2

3915. NUCLEAR MAGNETIC RESONANCE IN VERY WEAK FIELDS. I. A HERTZIAN SPECTROSCOPE FOR OBSERVATION OF RESONANCE BETWEEN 15 AND 2 kc/s. C.Manus, G.Béné, R.Extermann and R.Mercier.
Helv. phys. Acta, Vol. 28, No. 7, 617-25 (1955). In French.
Description of a spectrometer giving proton resonance signals of signal/noise ratio = 8 at 0.5 gauss, 2 kc/s with a sample of 2 litres of water. D.H.Whiffen

539.152.2

3916. NUCLEAR MAGNETIC RESONANCE IN VERY WEAK FIELDS. II. STUDY OF NUCLEAR MAGNETIC RESONANCE BETWEEN 2 AND 0.5 GAUSS. B.Cagnac, C.Manus, G.Béné and R.Extermann.
Helv. phys. Acta, Vol. 28, No. 7, 626-32 (1955). In French.
Describes the effect of variation of frequency, voltage etc. on the observed proton resonance signals especially the alteration in signal shape when $1/T_2$ is less than the modulation frequency. D.H.Whiffen

539.152.2

3917. ON THE MAGNETIC MOMENT OF THE PROTON. V.Thorsen.
Naturwissenschaften, Vol. 43, No. 4, 78 (1956). In German.
The magnetic moment is evaluated in terms of known constants. G.E.Brown

539.152.2

3918. MAGNETIC RESONANCE. J.Combrisson.
Onde élect., Vol. 35, 1101-7 (Nov., 1955). In French.
A review.

539.153

3919. DATA ON THE ATOMIC FORM FACTOR: COMPUTATION AND SURVEY. A.T.Nelms and I.Oppenheim.
J. Res. Nat. Bur. Stand., Vol. 55, No. 1, 53-62 (July, 1955).
Presents the results of calculations of atomic form

factors, based on tables of electron charge distributions computed from Hartree wave-functions, for a wide range of atomic numbers. Computations of the form factors for five elements — carbon, oxygen, iron, arsenic, and mercury — are presented and a method of interpolation for other atoms is indicated. A survey of previous results is given and the relativistic theory of Rayleigh scattering is reviewed. Comparisons of the present results with previous computations and with some sparse experimental data are made. A.

539.153

3920. COUPLING OF ELECTRONS WITH HIGH ORBITAL ANGULAR MOMENTUM, ILLUSTRATED BY 2p nf AND 2p ng IN N II. K.B.S.Eriksson.
Phys. Rev., Vol. 102, No. 1, 102-4 (April 1, 1956).

The theory for intermediate coupling has been studied in the pair-coupling approximation, and is shown to give an accurate description of the observed structure in N II $2s^2$ 2p nf and N II $2s^2$ 2p 5g. A.

539.153

3921. NUMERICAL VALUES FOR HYDROGEN FINE STRUCTURE. J.M.Harriman.
Phys. Rev., Vol. 101, No. 2, 594-8 (Jan. 15, 1956).

Bethe's "average excitation potentials" for states 1s through 4p of hydrogen are calculated numerically. These lead to values of the $n_0{}^2S_{1/2} - n_0{}^2P_{1/2}$ level shifts in hydrogen for $n_0 = 3$ and 4 of $\delta_H(3) = 314.690 \pm 0.047$ Mc/s and $\delta_H(4) = 132.998 \pm 0.020$ Mc/s, which are 1.44 Mc/s and 0.85 Mc/s larger than previous estimates. For $n_0 = 2$, a value of $\delta_H(2) = 1057.21 \pm 0.16$ Mc/s is obtained, which is in close agreement with previous calculation. In conjunction with this work, the oscillator strengths $f(n_0l_0, nl)$ are obtained for $n_0 = 1,2,3$ and 4; $n < 50$; and all values of l_0 and l. A generalization of the Wigner-Kirkwood sum rule is derived. A.

539.153

3922. THEORY OF IONIZATION PROBABILITY NEAR THRESHOLD. S.Geltman.
Phys. Rev., Vol. 102, No. 1, 171-9 (April 1, 1956).

The behaviour of the cross-section for ionization by electron impact is investigated in the vicinity of threshold by means of the quantum theory of inelastic scattering. A Coulomb-modified form of the Born approximation is used to calculate the S-wave ionization cross-sections for H^+, He^+ and He^{++}. The electron-nuclear interaction is included in the unperturbed Hamiltonian for the problem while the interaction between the incident and atomic electrons is considered as the perturbation. It can be shown that the limiting law for the ionization of a hydrogen atom has a linear dependence on the excess incident energy. The absolute cross-sections evaluated are in good agreement with experiment. Generalization of the excess energy dependence of the threshold law to the case of multiple (n-fold) ionization is found to yield the forms $E_{ex}{}^n$ for ionization by electron impact and $E_{ex}{}^{n-1}$ for photoionization. A.

539.153

3923. MEASUREMENT OF "OPTICAL" TRANSITION PROBABILITIES OF Cd. J.P.A.van Hengstum and J.A.Smit.
Physica, Vol. 22, No. 2, 86-98 (Feb., 1956).

Of 31 level combinations in the cadmium atom the probability of spontaneous transition was found from the spectrum of an arc discharge between carbon electrodes in air with Cd vapour. For that purpose the intensities of the Cd lines were measured on the one side, while on the other side the populations of the upper levels of those lines were calculated from the simultaneously measured arc temperature. The temperature was derived from intensity ratios in the CN bands also occurring in the arc spectrum. The measurements are only relative; since, however, of one line the absolute value of the transition probability was known by other methods the relative results could be converted into absolute values. Checking measurements showed the absence of disturbing self-absorption etc., and confirmed the validity of Boltzmann's formula for the level populations in the d.c. and a.c. arcs used. A

539.153 : 535.338.33

3924. NEW POINTS OF VIEW CONCERNING THE HYDROGEN ATOM AND THE HYDROGEN SPECTRUM. V.Thorsen
Fysisk T., Vol. 52, No. 1, 17-45 (1954). In Danish.

An attempt to interpret the quantum energies and orbital and spin magnetic moments by making use of the classical electrodynamics of a spinning charged sphere. A model is us which rests on analogies with capillary and gravitational waves, the stability of the ground state of hydrogen following from a relation between the two wavelengths which leads to standing waves. Fine structure, the Lamb shift, the anomalo electron magnetic moment and the decay of the neutron are discussed in terms of relations derived from the model.
W.J.Swiatecki

539.153 : 539.152.

3925. HYPERFINE STRUCTURE AND NUCLEAR MOMEN OF GADOLINIUM. D.R.Speck.
Phys. Rev., Vol. 101, No. 6, 1725-9 (March 15, 1956).

Study of the optical hyperfine structure of several Gd I lines using enriched isotopes shows that the spins of the odd isotopes Gd^{155} and Gd^{157} each are $\frac{3}{2}$. The ratio of the magnetic moments is $\mu_I(Gd^{155})/\mu_I(Gd^{157}) = 0.80 \pm 0.02$. The magne moment for Gd^{157} obtained from two lines is -0.37 ± 0.04 nm Deviations from the interval rule in these two lines can be accounted for with a quadrupole moment of approximately 1.0×10^{-24} cm^2 for Gd^{157} and 1.1×10^{-24} cm^2 for Gd^{155}. The known anomalous isotope shift between neutron numbers 88 and 90 (Gd^{152} and Gd^{154}) is accurately measured for several lines. A

539.155

3926. A LABORATORY METHOD FOR SEPARATING NITROGEN ISOTOPES BY ION EXCHANGE. F.H.Spedding, J.E.Powell and H.J.Svec.
J. Amer. Chem. Soc., Vol. 77, No. 23, 6125-32 (Dec.5, 1955

Various aspects of the separation of N^{15} and N^{14} isotopes from each other by an ion-exchange process are discussed. A number of experiments have been performed to establish the feasibility of using the process and to check the countercurrent theory of separation which has been developed. The separation factor for the exchange of N^{15} and N^{14} between a solution of dilute ammonium hydroxide and the ammonium form of Dowex 50-X12 was measured and found to be 1.0257 0.0002. It was shown that an adsorbed band of ammonium ion must be eluted about 39 times its length in order to achieve separation of the isotopes. A method of continuous operation using a series of ion-exchange beds is described. A

539.155.

3927. FAILURE OF THE IONIC CENTRIFUGE PRIOR TO THE IONIC EXPANDER. J.Slepian.
J. appl. Phys., Vol. 26, No. 10, 1283 (Oct., 1955).

A description is given of the phenomenological behaviou of the ionic centrifuge, under various parameter changes, in early (unsuccessful) experiments on isotope separation.
J.Hughe

539.155.

3928. ISOTOPIC ANALYSIS OF POLONIUM-208-209 MIXTURES. D.J.Hunt and G.Pish.
J. Opt. Soc. Amer., Vol. 46, No. 2, 87-91 (Feb., 1956).

Isotopic ratios of polonium, produced by proton bombardment of Bi^{209}, were determined from electrodeless discharge tubes by spectrographic methods. The ratios of polonium-209 to polonium-208 were calculated from intensity ratios of the band heads due to the two molecules, $(Po^{209})_2$ and $(Po^{208}Po^{209})$. It was found that a result with a probable error of ± 6% could be obtained from a single spectrogram. Comparison of spectrographic analysis with proton energy-yield data indicated agreement of the order of ± 20%. A

539.155.2

3929. SEARCH FOR POSSIBLE NATURALLY OCCURRING ISOTOPES OF LOW ABUNDANCE. F.A.White, T.L.Collins and F.M.Rourke.
Phys. Rev., Vol. 101, No. 6, 1786-91 (March 15, 1956).

A systematic search has been made for the existence of previously unobserved naturally occurring isotopes of low abundance. A two-stage mass analyser was employed. With the exception of Ta^{180}, none were found. The improved abundance sensitivity of the two-stage spectrometer, however, allowed determinations of lower experimental "upper limits" to be placed on a large number of isotopes. The elements, sodium, aluminium, scandium, niobium and caesium were confirmed to be monoisotopic. A comparison has also been made of abundance measurements obtained with this instrument to those obtained in previous investigations. A.

539.155.2 : 541.135.3

ISOTOPIC EFFECT DURING ELECTROLYTIC MIGRATION OF Li IONS IN MOLTEN LITHIUM NITRATE. See Abstr. 3338

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16.08

3930. DETERMINING CONCENTRATION OF AIRBORNE PLUTONIUM DUST. G.W.C.Tait.
Nucleonics, Vol. 14, No. 1, 53-5 (Jan., 1956).

An annular impactor with a sampling rate of 500-1000 l./min is described. This separates large (>1 μ) airborne particles from much smaller ones, thereby facilitating the counting of airborne Pu (large particles) from natural radioactive background (very small particles). L.R.Shepherd

539.16.08

3931. THE DETECTION OF NUCLEAR PARTICLES. CHOICE OF APPROPRIATE DETECTOR. A.Benoit and Y.Kœchlin.
Onde élect., Vol. 35, 955-73 (Nov., 1955). In French.

A general survey of the subject, written for the non-specialist prospective user. E.A.Ash

539.162

3932. CONTRIBUTION TO THE STUDY OF THE CAPTURE OF ELECTRONS FROM THE CLOUD BY THE NUCLEI OF ATOMS: THE EFFECT OF THE CORRELATIONS EXISTING BETWEEN THE POSITIONS OF THE ELECTRONS ON THE RATIO ρ OF THE PROBABILITY OF L CAPTURE TO THAT FOR K CAPTURE. S.Odiot and R.Daudel.
J. Phys. Radium, Vol. 17, No. 1, 60-2 (Jan., 1956). In French.

It is shown that this effect, which can be neglected for heavy atoms, increases the value of ρ by a factor of 10 in the case of the first triplet state of helium. J.Hughes

539.163

3933. TRANSPLUTONIUM ELEMENTS IN THERMONUCLEAR TEST DEBRIS. P.R.Fields, M.H.Studier, H.Diamond, J.F.Mech, M.G.Inghram, G.L.Pyle, C.M.Stevens, S.Fried, W.M.Manning, A.Ghiorso, S.G.Thompson, G.H.Higgins and G.T.Seaborg.
Phys. Rev., Vol. 102, No. 1, 180-2 (April 1, 1956).

The isotopes of curium, berkelium and californium found in the thermonuclear debris of the November 1952 thermonuclear test are discussed. The instantaneous buildup of the heavy elements in the thermonuclear device is compared with the buildup during pile irradiation. The alpha-particle energy (6.4 MeV) and the spontaneous fission half-life (< 1.2×10^7 years) of Cm^{246} are reported. The spontaneous fission half-life of Cf^{254} was found to be 55 days. No other mode of decay was observed for this isotope. A.

539.163

3934. ISOTOPES OF EINSTEINIUM AND FERMIUM PRODUCED BY NEUTRON IRRADIATION OF PLUTONIUM. M.Jones, R.P.Schuman, J.P.Butler, G.Cowper, T.A.Eastwood and H.G.Jackson.
Phys. Rev., Vol. 102, No. 1, 203-7 (April 1, 1956).

Samples of einsteinium and fermium have been separated from neutron-irradiated plutonium and carefully purified. Four isotopes of einsteinium were found: 20.03 day E^{253}, emitting 6.636 MeV and 6.24 MeV alpha-particles and 42 and 393 keV gamma-rays, both magnetic dipole transitions, and with a spontaneous fission half-life of 7×10^5 years; 38.5 hr E^{254m}, a beta emitter with 1.04 MeV beta-rays and 0.680 MeV gamma-rays; ~ 320 day E^{254}, an alpha emitter with 6.42 MeV alpha-particles; and 24 day E^{255}, a beta emitter. Two fermium isotopes were found: 3.24 hr Fm^{254} emitting 7.20 MeV alpha-particles and with a spontaneous fission half-life of 246 days; and 21.5 hr Fm^{255} emitting 7.08 MeV alpha-particles. A.

539.163

3935. DECAY OF Rb^{89}. G.D.O'Kelley, N.H.Lazar and E.Eichler.
Phys. Rev., Vol. 102, No. 1, 223-7 (April 1, 1956).

Sources of Rb^{89} were prepared from the decay of fission product Kr^{89} and studied by scintillation methods. The half-life was found to be 14.9 ± 0.3 min. Gamma-rays of energy 0.663 ± 0.006, 1.05 ± 0.02, 1.26 ± 0.01, 1.55 ± 0.03, 2.20 ± 0.02, 2.59 ± 0.03, 2.75 ± 0.05 and 3.52 ± 0.07 MeV and relative intensity 0.217 ± 0.026, 1.00, 0.717 ± 0.090, 0.048 ± 0.010, 0.190 ± 0.025, 0.169 ± 0.031, 0.037 ± 0.007 and 0.029 ± 0.005 were measured. Gamma-gamma coincidence spectroscopy and summing of gamma-rays in a 4¾-inch diameter NaI(Tl) crystal, used in anticoincidence with a surrounding solution phosphor tank, establish a decay scheme with levels in Sr^{89} at 1.05, 2.31, 2.59, 2.75, 3.25 and 3.52 MeV. The ground-state beta-ray transition was measured as 3.92 ± 0.05 MeV and is present in about 7% of the beta-ray transitions. A.

539.163

3936. THE ISOMERS OF ^{190}Os AND ^{190}Ir. A.H.W.Aten, Jr, G.D.De Feyfer, M.J.Sterk and A.H.Wapstra.
Physica, Vol. 21, No. 9, 740-2 (Sept.); Erratum, No. 12, 990 (Dec., 1955).

Isomers of Ir^{190} ($\frac{1}{2}$-lives 3 hr and 11 days) and of Os^{190} (10 min) were obtained after chemical separation from metallic Ir irradiated by fast neutrons; a decay scheme (incomplete) of the isotopes of mass 190 is given. A.O.Stanesby

539.163

3937. RADIOACTIVE DECAY OF Co^{57}. W.C.Middelkoop, A.Heyligers, L.H.T.Rietjens, H.J.van den Bold and P.M.Endt.
Physica, Vol. 21, No. 11, 897-8 (Nov., 1955).

An upper limit of 0.1% was found for the occurrence of positrons in the decay of Co^{57}. By delayed coincidence measurements it was shown that the 123 keV—14 keV cascade in Fe^{57} proceeds through a 14 keV level. J.Hughes

539.163

3938. DECAY OF SAMARIUM 143. M.Mirnik and A.H.W.Aten, Jr.
Physica, Vol. 22, No. 1, 14-16 (Jan., 1956).

Sm^{143} decays with a 8.3 min period by emission of positons with a maximum energy of 2.3 MeV. No γ-rays were observed with an energy of more than 0.15 MeV. A.

539.163.1

3939. THE PERIOD OF THE 122 keV LEVEL OF Cs^{131}. H.Vartapétian, L.Dick, R.Foucher and N.Perrin.
C.R. Acad. Sci. (Paris), Vol. 242, No. 1, 103-5 (Jan. 4, 1956). In French.

The period has been measured by the method of délayed coincidences between the 495 and 122 keV γ-rays arising from the de-excitation of the 615 keV level. The value is 4 ± 0.3 x

10^{-9} sec. The transition to the ground state is interpreted as an M_1 transition forbidden for $\Delta L = 2$; the ground state being a $d_{5/2}$ level and the 122 keV level being $g_{7/2}$. D.J Prowse

539.163.1

3940. SEVEN NEW ISOMERS WITH HALF-LIVES BETWEEN 10^{-5} AND 10^{-1} SECOND. S.H.Vegors, Jr and P.Axel.
Phys. Rev., Vol. 101, No. 3, 1067-73 (Feb. 1, 1956).

Isomers with half-lives greater than 10^{-5} sec were sought between the 180-cycle 1 microsecond yield pulses of a 24 MeV betatron. The following new activities were observed:

Bombarded element	Half-life (μsec)	Energy (keV)
As	12 000 ± 3000	305 ± 15
Mo	16.5 ± 1.2	98 ± 5
Pd	33 ± 6	165 ± 15 305 ± 15
W	16.0 ± 1.0	370 ± 15
Tl	65 ± 5	410 ± 15 706 ± 20
Tl	530 ± 50	506 ± 15
Bi	2700 ± 250	500 ± 20 930 ± 30

Additional results include (1) a new half-life determination of Y^{88m} as 287 ± 15 μsec, (2) threshold measurements for several of the activities, and (3) negative results in looking for W^{180m} and Na^{22m}. A.

539.163.1

3941. NEW ISOTOPE OF BERKELIUM. E.K.Hulet.
Phys. Rev., Vol. 102, No. 1, 182 (April 1, 1956).

A new isotope of berkelium, Bk^{248}, formed by a 25 MeV helium-ion bombardment of a mixture of curium nuclides has been found. Its existence and a half-life of 23 ± 5 hr were determined by periodically separating the β^- decay daughter, Cf^{248}, from the mixture of berkelium isotopes isolated after the bombardment. A.

539.163.1

3942. ZINC 60 AND 61. L.Lindner and G.A.Brinkman.
Physica, Vol. 21, No. 9, 747-8 (Sept., 1955).

Identification of these nuclides formed in the bombardment of Ni with 52 MeV He^{2+} ions was made by determining the growth of $Cu^{60,61}$ activities in the Zn fraction. Zn^{60} was found to have a half-life of 2.1 ± 0.1 min and Zn^{61} to decay by β^+-emission (E_{max} = 4.8 ± 0.3 MeV) with a half-life of 89 ± 2 sec. M.A.Grace

539.163.1

3943. MEASUREMENT OF γ-TRANSITION LIFETIMES BY RECOIL METHODS. II. M1 TRANSITIONS IN ^{7}Li AND ^{7}Be. D.St P.Bunbury, S.Devons, G.Manning and J.H.Towle.
Proc. Phys. Soc. A, Vol. 69, Pt 2, 165-72 (Feb., 1956).

The methods described in Pt I (Abstr. 2110/1955) have been applied to the measurement of the mean lifetimes of the first excited states of the mirror nuclei Li^7 and Be^7. The experimental results are, respectively, $7.7 \pm 0.8 \times 10^{-4}$ sec and $2.7 \pm 1.0 \times 10^{-13}$ sec. The accuracy of these results is limited, particularly in the latter case, by inadequate knowledge of the range-velocity relationship for these nuclei in heir passage through solid materials. A.

539.163.1

3944. MEASUREMENT OF γ-TRANSITION LIFETIMES BY RECOIL METHODS. III. E2 TRANSITIONS IN SOME EVEN-EVEN NUCLEI. S.Devons, G.Manning and J.H.Towle.
Proc. Phys. Soc. A, Vol. 69, Pt 2, 173-7 (Feb., 1956).

The mean lives of the first 2+ states of C^{12}, O^{16}, Ne^{20} and Si^{28} have been measured using recoil methods with following results:

C^{12} $\tau = 2.6 \pm 0.9 \times 10^{-14}$ sec.
O^{16} $\tau < \sim 2.5 \times 10^{-14}$ sec.
Ne^{20} $\tau = 7.6 \pm 3.3 \times 10^{-13}$ sec.
Si^{28} $9 \times 10^{-13} < \sim\tau$ (or $\tau < \sim 3 \times 10^{-14}$). A.

539.163.2

3945. ON THE DISINTEGRATION OF Hg^{198}, Hg^{194} AND Hg^{19}. J.Brunner, H.Guhl, J.Halter and H.J.Leisi.
Helv. phys. Acta, Vol. 28, No. 5-6, 475-8 (1955). In German.

These nuclides were obtained by the irradiation of Au by 33 or 55 MeV protons, and the disintegration products examined using β- and β-γ-coincidence-spectrometers. A.O.Stanesby

539.163.2

3946. DECAY OF ^{134}Cs. H.H.Forster and J.S.Wiggins.
Nuovo Cimento (Ser. 10), Vol. 2, No. 4, 854-6 (Oct., 1955).

The complex β-spectrum was resolved into two components with linear Fermi plots and end point energies of 80 ± 3 keV (28%) and 650 ± 5 keV (56%). Internal and external conversion electron groups indicate γ-rays of 204 ± 5, 475 ± 3, 562 ± 2, 569 ± 1, 604 ± 1, 796 ± 1, 802 ± 1, 1035 ± 3, 1167 ± and 1369 ± 3 keV of relative intensities 0.1, 0.04, 0.14, 0.12, 1.00, 0.72, 0.11, 0.05, 0.03 and 0.05. A level scheme is suggested. M.A.Grace

539.163.2

3947. DECAY OF Sb^{127} AND Sb^{129}. M.C.Day, Jr and A.F.Voigt.
Phys. Rev., Vol. 101, No. 6, 1784-6 (March 15, 1956).

The techniques of scintillation spectrometry have been applied to the study of the decay of Sb^{127} and Sb^{129}. Both decays were found to be too complex to permit complete analysis in the present experiments, but a number of beta- and gamma-ray transitions were measured for each nuclide. In the decay of 93 hr Sb^{127} three beta-ray groups and eight gamma-ray tra sitions were measured. Coincidences were observed among several pairs of these transitions. In the 9.2 hr Sb^{129} four gamma-rays were observed and measured and the end-point energy of the most energetic beta transition was determined. A

539.163.

3948. DECAY SCHEME OF Au^{194}. M.T.Thieme and E.Bleuler.
Phys. Rev., Vol. 102, No. 1, 195-9 (April 1, 1956).

The radiations of the 40 hr Au^{194} were investigated with a scintillation and a magnetic lens spectrometer, using coincidence techniques. First forbidden positron transitions with endpoints of 1.55 ± 0.02 and 1.21 ± 0.02 MeV were found to lead to the ground state and the first excited state of Pt^{194}. Most of the transitions and levels of Pt^{194} known from the decay of Ir^{194} were confirmed. Additional gamma-rays of ~95 1590 ± 20, 1890 ± 20, and 2150 ± 15 keV were observed, indicating new levels at 2150 and 2215 keV. A

539.163.2

3949. DECAY OF THE NEW NUCLIDE Ne^{24}. B.J.Dropesky and A.W.Schardt.
Phys. Rev., Vol. 102, No. 2, 426-33 (April 15, 1956).

The nuclide Ne^{24} has been produced by bombarding a neon gas target with 1.5 MeV tritons, the reaction being Ne^{22}(t, p)Ne Beta and gamma scintillation spectrometers with coincidence circuits were used to study this nuclide. Ne^{24} decays with a hal life of 3.38 ± 0.02 min, emitting negative beta groups of 1.98 ± 0.05 and 1.10 ± 0.05 MeV. This decay is also accompanied by gamma-rays of 472 ± 5 and 878 ± 9 keV with relative intensitie of 100 to 8, respectively. The excited levels in Na^{24} correspon ing to the above transitions are at 0.472 and 1.35 MeV. The 0.472 MeV level is an isomeric state with a half-life of the order of 20 milliseconds. The spins and parities of the Na^{24} ground state, 0.472 MeV, and 1.35 MeV levels are 4+, 1+ and 1+, respectively. The Ne^{24}–Na^{24} energy difference is 2.449 ± 0.035 MeV, and the Ne^{24} mass is 24.001 195 ± 0.000 040 atomic mass units. A.

539.163.2

3950. ON THE DECAY OF ^{203}Tl. P.Kramer, H.C.Hamers

and G.Meijer.
Physica, Vol. 22, No. 3, 208-12 (March, 1956).

The radiations from Tl^{202}, decaying by K and L electron capture, were investigated by different methods. The L/K capture ratio was found to be 0.9 ± 0.27. From this ratio, the suggested decay scheme and the equation of Marshak, the total transition energy was found to lie between 0.54 MeV and 0.75 MeV. A.

539.164

3951. UPPER LIMIT OF α-PARTICLE BRANCHING IN UX_1 (Th^{234}). S.Deutsch and M.Nikolic.
Nuovo Cimento (Ser.10), Vol. 2, No. 6, 1326-7 (Dec., 1955). In French.

This was obtained from the number of α-particle tracks in nuclear emulsions impregnated with a known quantity of Th^{234}; the measured value for α/β was $< 10^{-6}$ (expected value $\sim 2 \times 10^{-15}$). A.O.Stanesby

539.164.74

3952. DEVIATIONS FROM THE LAW OF ADDITIVITY IN THE STOPPING OF ALPHA PARTICLES. L.Chollet and J.Rossel.
Helv. phys. Acta, Vol. 28, No. 5-6, 466-70 (1955). In French.

For gases it was found that there was no deviation from the additivity law of atomic stopping powers, even for α-particle energies of ~ 3 MeV, greater than ~2%, i.e. within the experimental error. J.Hughes

539.164.74

3953. ENERGY PER ION PAIR IN POLYATOMIC GASES FOR Po α-PARTICLES. C.Biber, P.Huber and A.Müller.
Helv. phys. Acta, Vol. 28, No. 5-6, 503-21 (1955). In German.

Values of the average energy-loss W per ion pair for Po α-particles has been measured for N_2, H_2, CH_4, BF_3, H_2S, NH_3, CO_2, SO_2, CCL_4, C_2H_5OH, butane and air. Ion collection (Q) is measured for various field intensities (E) and for pressures up to 12 atm. (see Abstr. 4885/1953). For the chemically active gases, an ionization chamber with chromium plated lining and glass insulators is used. 1/E is plotted against 1/Q with pressure as parameter, and the curves extrapolated back to 1/E = 0 to give a true value (Qo) of the charge collected. Qo is independent of pressure (in agreement with Jaffé's theory) except for CO_2. This was noted previously (Abstr. 4885/1953) and the anomaly is now found to be reduced by vigorous purification of the CO_2 used, and by collecting electrons rather than heavy ions. A table comparing these results with those of other authors is given. The value of W for air is determined as 34.3 ± 0.3 eV. D.V.Mabbs

539.165

3954. POSITRONS FROM THE DECAY OF P^{32} AND Y^{90}. J.S.Greenberg and M.Deutsch.
Phys. Rev., Vol. 102, No. 2, 415-21 (April 15, 1956).

A magnetic focusing arrangement is combined with coincidence counting of the annihilation radiation to permit detection of very low positron intensities in the presence of other radiations. Sources of P^{32} yielded $(7.5 \pm 2) \times 10^{-10}$ positrons per beta decay. An experiment with a gold-covered source showed that secondary effects in the source material may contribute an important fraction of these positrons. One may conclude that the number of positrons per beta decay of P^{32} does not exceed by more than a factor two the value 5.5×10^{-10} expected theoretically from electromagnetic effects and is probably close to the theoretical value. Sources of Y^{90} emit $(3.6 \pm 0.9) \times 10^{-5}$ positrons per beta decay, due primarily to the 1.75 MeV electric monopole transition in Zr^{90}. A.

539.165 : 539.166

3955. β-γ ANGULAR CORRELATION OF $^{214}_{83}Bi$. F.Demichelis and L.A.Radicati.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 152-9 (Jan., 1956).

The angular correlation between the β-transition (2.56 MeV) originating from the ground state of $_{83}Bi^{214}$ and the γ-ray (0.61 MeV) to the ground state of $_{84}Po^{214}$ has been measured. From the knowledge of the log ft values of the two β-transitions (2.56 MeV and 3.17 MeV) originating from $_{83}Bi^{214}$ and the measurement of the angular correlation coefficient, the value 2- is deduced for the spin and the parity of the ground state of $_{83}Bi^{214}$. A.

539.165 : 539.166

3956. ON THE β–γ ANGULAR CORRELATIONS OF Tm^{170} AND Sb^{124}. VT INTERACTION. Y.Kato and M.Morita.
Progr. theor. Phys., Vol. 13, No. 3, 276-84 (March, 1955).

The authors have calculated the β-ray angular distribution functions $F_{LL'}{}^{M}(\theta)$ for the interference between different types of the Fermi interactions in the second forbidden transition, taking into account the effect of the nuclear charge to the emitted electron. The investigation of the β–γ angular correlation is performed in the case of Tm^{170}, assuming the linear combination of vector and tensor interactions. With this combination, they have also given the formulae of β–γ angular correlation for Sb^{124}. A.

539.165.2

3957. NUCLEAR MATRIX ELEMENT FOR β-DECAY AND THE RATIO OF COUPLING CONSTANTS. J.Fujita.
Progr. theor. Phys., Vol. 13, No. 3, 260-4 (March, 1955).

The nuclear matrix elements for the β-decay in the second and the third forbidden transitions are derived on Bohr's collective model. The results are used for determining the ratio of the scalar and the tensor coupling constants in the analysis of the β-decay of Rb^{87}, Cs^{137}, Tc^{99} and Fe^{59}, in terms of a linear combination of the scalar and the tensor Fermi interactions A.

539.165.2 : 539.132

3958. MOLECULAR EXCITATION IN BETA DECAY. M.Cantwell.
Phys. Rev., Vol. 101, No. 6, 1747-56 (March 15, 1956).

The theory of molecular excitation in beta decay is developed for the general case of a polyatomic molecule. Calculations of the daughter molecule vibrational excitation are carried through for diatomic molecules, and the results are presented graphically. Finally, the formation of the $(He^3H^3)^+$ molecule ion in the decay of one nucleus of a tritium molecule is studied in detail. It is concluded that the $(He^3H^3)^+$ ground electronic state vibrational spectrum should be observable in the light spontaneously emitted by tritium. For example, neglecting non-radiative transitions, one expects approximately 10^{14} photons per second to be radiated at wave number $\cong 2.35 \times 10^3$ cm^{-1} by every gram of tritium in the $1 \rightarrow 0$ vibrational transition. A.

539.166

3959. GAMMA RAYS FROM EXCITED LEVELS IN Al^{25}. H.Ager-Hanssen, O.M.Lönsjö and R.Nordhagen.
Phys. Rev., Vol. 101, No. 6, 1779-83 (March 15, 1956).

To measure the energy of γ-rays following resonances in the $Mg^{24}(p, \gamma)Al^{25}$ reaction, thin targets of natural magnesium have been bombarded with protons. The radiation of the resonances at 222, 418 and 825 keV proton energy have been investigate, and the γ-ray spectra have been observed with a single NaI(Tl) crystal scintillation counter and a Hutchinson and Scarrott pulse-height analyser. Several γ-rays are identified in the spectra, corresponding to transitions from excited levels in Al^{25} at 3.08 ± 0.03, 2.69 ± 0.02, 2.50 ± 0.06, 1.80 ± 0.02, 0.95 ± 0.08 and 0.45 ± 0.06 MeV energy. From estimates of the γ-ray intensities spin assignments are given: For the 2.69 MeV level in Al^{25}, $\frac{3}{2}$+; for the 2.50 MeV level, $\frac{1}{2}\pm$; for the 1.80 MeV level, $\frac{3}{2}$–; and for the 0.95 MeV level, $\frac{3}{2}$+. No γ-rays were found to accompany the 7 sec positron activity from Al^{25}. A measurement of the radiation from the annihilation of the positrons is included. A.

539.166

3960. GAMMA RAYS FROM THE PROTON BOMBARDMENT OF Mg^{24}. A.E.Litherland, E.B.Paul, G.A.Bartholomew and H.E.Gove.
Phys. Rev., Vol. 102, No. 1, 208-22 (April 1, 1956).

The reactions $Mg^{24}(p,\gamma)Al^{25}$, Q = 2.29 MeV, and $Mg^{24}(p,p'\gamma)Mg^{24}$, Q = −1.37 MeV, have been measured for proton energies in the range 0.40 to 3.0 MeV. New levels in Al^{25} have been found at 1.61, 3.44, 4.90, 5.06, 5.10 MeV, and possibly at 5.09 MeV. Appropriate angular distribution measurements of proton-capture gamma-rays and gamma-rays from inelastic proton scattering, combined with previous measurements by other investigators, allow unambiguous spin and parity assignments to be made for all known levels in Al^{25} up to 4.7 MeV with the exception of those at 1.61, 2.51 and 3.44 MeV, where the assignments are less certain. The gamma-ray branching ratios for all the levels up to 4.7 MeV have been measured, as well as absolute values of the product of Γ_p/Γ and the partial widths for primary gamma transitions and inelastic proton scattering for states above the proton binding energy. In several cases, intensity ratios of E2 - M1 mixtures were obtained. An interpretation of some of the results based on a collective model of the Al^{25} nucleus is given. A.

539.166

3961. GAMMA–GAMMA ANGULAR CORRELATION IN Sr^{88}. E.D.Klema.
Phys. Rev., Vol. 102, No. 2, 449-50 (April 15, 1956).

The directional angular correlation of the 909-1850 keV $\gamma-\gamma$ cascade in Sr^{88} has been measured with a coincidence scintillation spectrometer using NaI detectors. For a dilute YCl_3 aqueous solution source, the observed correlation function, after correction for the finite angular resolution of the detectors, is given by $W(\theta) = 1-(0.0699 \pm 0.0025)\, P_2(\cos\theta)$. The theoretical correlation function for the sequence 3(D)2(Q)0 is $W(\theta) = 1-0.07143 P_2(\cos\theta)$; hence it is concluded that both of the transitions in the cascade are pure multipoles. A.

539.166

3962. RADIATIONS OF COPPER 59. L.Lindner, G.A.Brinkman and A.C.Pieterse.
Physica, Vol. 21, No. 9, 745-6 (Sept., 1955).

Bombardment of Ni with deuterons (5-22 MeV) yields a Cu nuclide of half-life 82 ± 1 sec believed to be Cu^{59}. This decays by β^+ emission (by absorption E_{max} is 3.4 ± 0.5 MeV). Gamma-rays of 0.88 ± 0.02 and 1.31 ± 0.02 MeV were found together with evidence for γ-radiation between 1.5 and 3 MeV. M.A.Grace

539.166 : 539.152.2

3963. TIME-DEPENDENT DIRECTIONAL CORRELATION OF 1.1-HR Pb^{204}. G.K.Wertheim and R.V.Pound.
Phys. Rev., Vol. 102, No. 1, 185-9 (April 1, 1956).

A study is made of an effect attributable to the interaction of the electric quadrupole moment of the 0.27μsec level of Pb^{204} with the crystalline electric field in metallic, polycrystalline, thallium in which 68 min Pb^{204} is produced by (p, 2n) reaction. The directional anisotropy in the rate of delayed coincidences between the γ-ray preceding the 0.27μsec state and the γ-rays following the state is observed as a function of the delay time. Although some discrepancy between the observed function and theory is found, the time dependence suggests a coupling frequency $eQ(\partial^2V/\partial z^2)/h$ of 12 Mc/s. Measurements of the directional correlation between the two γ-rays in prompt coincidence following the 0.27 μsec state supports the assignment, by Krohn and Raboy, of spin 4 to that state and of some mixing of M3 with the dominantly E2, 371 keV γ-ray. Evidence of prompt γ-rays of several energies, following K-capture in 12 hr Bi^{204}, is also found. A.

539.166 : 539.152.2

3964. DIRECTIONAL CORRELATIONS AND ELECTRIC QUADRUPOLE MOMENTS OF MERCURY ISOTOPES. R.V.Pound and G.K.Wertheim.
Phys. Rev., Vol. 102, No. 2, 396-9 (April 15, 1956).

The directional correlation of the 368 keV and the 159 keV γ-rays of 44 min Hg^{199} were studied with sources in the form of liquid metal, and dry crystalline $HgCl_2$. The results in the liquid metal, if free of scattering and of disturbances in the intermediate state, indicate a mixing of 0.8% E5 with the predominantly M4 first γ-ray, assuming the second to be pure E2. The disturbance observed in the frozen metal suggests a static electric quadrupole interaction $eQ(\partial^2V/\partial z^2)/h$ of 593 Mc/s whereas that in $HgCl_2$ suggests similar interaction of 1100 Mc/s for the 2.35-mμsec intermediate state. If the second γ-ray is a rotational transition, an intrinsic quadrupole moment determined from the intermediate lifetime can be used together with these values and the coupling observed for Hg^{201} in $HgCl_2$ to compute the electric quadrupole moment of Hg^{201}. The resulting value of $0.46_{-0.11}^{+0.28}$ barn is in excellent agreement with the spectroscopically determined value of 0.45 ± 0.04 obtained by Murakawa. A.

539.166 : 539.172.13

3965. GAMMA RADIATION FROM THE PROTON BOMBARDMENT OF BORON TEN. G.B.Chadwick, T.K.Alexander and J.B.Warren.
Canad. J. Phys., Vol. 34, No. 4, 381-8 (April, 1956).

The gamma rays resulting from the bombardment of B^{10} with protons of energies from 0.5 to 2.0 MeV have been observed with a sodium iodide scintillation counter. Capture radiation, of energy $E_\gamma = 8.81 \pm 0.05 + 10/11\, E_p$ MeV, showed a broad resonance at $E_p = 1135 \pm 15$ keV. At this energy, the radiation had an angular distribution of the form $1 + (0.50 \pm 0.05)\cos^2\theta$ and a total cross-section $(3.5 \pm 1.0)\, 10^{-30}$ cm^2. Several lower-energy radiations were also observed and assigned tentatively to cascade transitions in C^{11}. The cross-section for the 430 keV radiation from the reaction $B^{10}(p,\alpha\gamma)Be^7$ was found to be 0.21 ± 0.05 barn at E_p = 1.52 MeV. This radiation was found to be isotropic. A.

539.166 : 539.172.4

3966. GAMMA RADIATION FROM INELASTIC SCATTERING OF FAST NEUTRONS BY ISOTOPES OF TELLURIUM, NICKEL AND COPPER. R.M.Sinclair.
Phys. Rev , Vol. 102, No. 2, 461-4 (April 15, 1956).

Gamma radiation from 4.4 ± 0.1 MeV neutron bombardment of separated isotopes was observed with a single-crystal NaI(Tl) spectrometer. Gamma rays assigned to inelastic scattering are (energies in MeV): Te^{128}, 0.68 ± 0.02, 1.38 ± 0.04; Te^{128}, 0.76 ± 0.02; Te^{130}, 0.83 ± 0.02; Ni^{58}, 1.01 ± 0.01, 1.46 ± 0.02; Cu^{63}, 0.65 ± 0.01, 0.97 ± 0.01, 1.34 ± 0.03, 1.43 ± 0.05; Cu^{65}, 1.12 ± 0.02. A 1.35 ± 0.02 MeV gamma ray is assigned to Ni^{60} by elimination. Relative yields of the gamma rays are given and their assignment to various excited states of the target nuclei is discussed. A.

539.166.08

3967. A METHOD FOR THE ANALYSIS OF COMPLICATED NUCLEAR SPECTRA WITH THE HELP OF DIRECTIONAL CORRELATION. P.Debrunner, E.Heer and R.Rüetschi.
Helv. phys. Acta, Vol. 28, No. 5-6, 473-5 (1955). In German.

It is suggested that in cases where several γ-ray cascades originate from one level, analysis may be possible if one of the cascades has its correlation perturbed either by nuclear quadrupole coupling, or the life time of an intermediate state being longer than the coincidence-circuit resolving time. J.Hughes

539.166.08

3968. GLASS DOSIMETRY. S.Davison, S.A.Goldblith and B.E.Proctor.
Nucleonics, Vol. 14, No. 1, 34-9 (Jan., 1956).

A detailed investigation of the characteristics of Ag-activated phosphate glass, in high radiation dosimetry, is described. The glass examined was 50% $Al(PO_3)_3$, 25%

$Ba(PO_3)_2$ and 25% KPO_3 with about 8% $AgPO_3$ added. Curves of optical densities at different wavelengths, as a function of Co^{60} gamma-radiation dose, are given. The log optical density increases almost linearly with log dose up to 3×10^5 rep, but flattens off at higher doses. Heating to 100-150° C reduces optical density, but the reduction ceases after about 10 min. After heating storage fading and its temperature dependence were found to be reduced. The sensitivity of the glass was found to be independent of dose rates and was not effected by repeated high temperature erasures of the coloration.

L.R.Shepherd

539.166.08

3969. A SYSTEM OF MEGAROENTGEN GLASS DOSIMETRY. N.J.Kreidl and G.E.Blair.
Nucleonics, Vol. 14, No. 1, 56-60 (Jan., 1956).

Soda-lime-silicate glasses with up to 16% by weight of cobalt oxide were found to exhibit a response to gamma radiation comparable to silver activated phosphate glass. The radiation response of the cobalt glass is easier to control in manufacture than is the response of the silver glass.

L.R.Shepherd

539.166.08

3970. PHOTOGRAPHIC METHODS IN γ-RAY SCINTILLATION SPECTROSCOPY. B.Chinaglia and F.Demichelis.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 51-8 (Jan., 1956).

The spectrum is always strongly disturbed by the Compton distribution; the possibilities of reducing it by a suitable geometry of the crystals and an anticoincidence device, or by using a crystal of the right size, are discussed. In any case the resolving power is rather poor owing to the fluctuations in every stage of the process from the incident γ-ray to the recorded pulse. But considerable improvements have been effected by a number of laboratories both in the photomultipliers and in the crystals and their mounting. This is proved by the comparison of up to date spectrograms with those which it was possible to obtain only a few years ago. A.

539.166.75

3971. GAMMA-RAY ATTENUATION. D.G.Chappell.
Nucleonics, Vol. 14, No. 1, 40-1 (Jan., 1956).

Mass absorption coefficients are plotted against atomic number for the range of photon energies up to 6 MeV A nomograph connecting, mass and linear absorption coefficients, shield thicknesses for various attenuation factors and the density of the shielding material, is given.

L.R.Shepherd

539.166.83

3972. MEASUREMENT OF THE COEFFICIENTS OF INTERNAL CONVERSION OF γ-RAYS OF Sr^{87*}, In^{113*}, In^{115*} AND V^{51*} ON THE ELECTRONS OF THE ATOMS.
I.V.Estulin and E.M.Moiseeva.
Zh. eksper. teor. Fiz., Vol. 28, No. 5, 541-6 (1955). In Russian. English translation in Soviet Physics JETP (New York), Vol. 1, No. 3, 463-7 (Nov., 1955).

The total coefficients of internal conversion of γ-rays of Sr^{87*}, In^{113*}, In^{115*} and V^{51*} on the electrons of the atoms are determined by the method of direct measurement of the number of electrons and γ-quanta which are emitted by the source. The corresponding values, which have been found, i.e., 0.26 ± 0.03, 0.39 ± 0.04, 0.9 ± 0.6 and $(3.1 \pm 0.2) \times 10^{-3}$ give basis for the conclusion that the isotopes Sr^{87*}, In^{113*} and In^{115*} have electric 2^5 pole radiation transition and that V^{51*} has electric quadrupole radiation transition. A.

539.166.832

3973. EXPERIMENTAL MEASUREMENTS ON DOUBLE COMPTON EFFECT. A.Bracci, C.Coceva, L.Colli and R.D.Lonati.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 203-13 (Jan., 1956).

The cross-section of the double Compton effect in the particular case of incident γ-rays of about 1 MeV energy and of scattered γ-rays making an angle of 90° throughout with each other and with the incident γ, has been experimentally measured, and the energy distribution of the scattered γ has been observed. The scattered γ-rays are detected by means of two scintillation spectrometers which use sodium iodide crystals and EMI photomultipliers working in coincidence. The pair of pulses from the photomultipliers, corresponding to γ-rays which give rise to a coincidence, are sent to a cathode-ray tube on whose screen they are photographed and then analysed. Experimental results obtained in the present work, regarding both the cross-section value and the energy distribution, are in good agreement with the theoretical one calculated by Mandl and Skyrme. A.

NUCLEAR REACTIONS 539.17

539.17 : 537.521

3974. ON THE POSSIBILITY OF PRODUCING THERMONUCLEAR REACTIONS IN A GAS DISCHARGE.
I.V.Kurchatov.
Text of a lecture delivered at the Atomic Energy Research Establishment, Harwell, April 25, 1956; printed in Moscow, 1956, in Russian and English.

A survey of some work of the Russian Academy of Sciences carried out since 1950. The magnitude of the problem is defined: Deuterium or deuterium–tritium mixtures must be heated to temperatures exceeding about 5×10^5 °K. All methods of achieving this demand the isolation of the hot gas from the walls of the container. In the work described, this was attempted by using the self-magnetic constriction of an arc discharge. Discharges of from 10^5 to 2×10^5 A in H_2, D_2, He, A, Xe and mixtures thereof were studied at pressures of from 5 μ of Hg to one atmosphere, in discharge tubes, mostly straight, between several centimetres and two metres in length and from 5 to 60 cm in diameter. The current was supplied by a capacitor bank of several hundred microfarads charged up to some tens of kV. The small parasitic inductances of 0.02-0.03 microhenry allowed current rises of between 10^{10} and 10^{12} A/sec.

The discharges were studied with oscillographs, high-speed cameras, electro-explosively operated Kerr cells, spectroscopy, pressure measurements made with piezoelectric devices placed in the plasma, neutron and X-ray intensities, and probe measurements of the magnetic and electric field strengths. The inductance, and hence the radius of the discharge column, was found from the current/voltage oscillograms. The main characteristics described are as follows: Directly after breakdown the current is carried only in a thin cylindrical layer adjacent to the tube walls, because of the skin effect. This cylindrical layer contracts, carrying with it and simultaneously ionizing the bulk of the gas, at rates of up to $\sim 10^7$ cm/sec, until the discharge reaches a minimum diameter on the axis of the tube. At this point the axial current density exceeds the mean current density over the tube by several dozen times. The plasma then expands and contracts again; sometimes three successive oscillations were observed. Viewing the initial contraction as a shock wave process, theory predicts, in agreement with observation, that the duration of the contraction is proportional to $M^{1/4} V_0^{-1/2}$, where M is the mass of gas per unit length, and V_0 is the initial voltage. Neutrons and X-rays (of up to 4×10^5 eV) were produced, but only in short bursts which coincided with the second constriction when the applied voltage was only about 10 kV. Although control experiments exclude the possibility that the neutrons are produced by deuteron collisions at the walls, it seems unlikely that the neutron emission arises from quasi-stationary heating of the plasma, during which the ion temperature increases as the square of the current. More likely is some electrodynamic accelerating mechanism depending on the

interaction of shock waves and the self-magnetic field, which produces large electric fields on the axis of the discharge. Not all of this mechanism is clear. R.S.Pease

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172

3975. NUCLEAR INTERACTIONS OF NEGATIVE K-MESONS IN NUCLEAR-RESEARCH EMULSION. E.P.George, A.J.Herz, J.H.Noon and N.Solntseff.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 94-117 (Jan., 1956).

A large emulsion stack was exposed at the Bevatron to K^--mesons of life time of the order of 10^{-8} sec. Fifty-two K^--particles were observed, among which 12 stopped with no visible decay or interaction, 28 ended in an evaporation star, 9 gave a fast π^--meson as well as an evaporation star, 1 ejected a hyperon and a π^--meson, 1 produced the emission of what may be either a hyperdeuteron coming to rest or a Σ^+ decaying into a proton in flight, and there is 1 case of an evaporation star closely associated with a possible Λ^0-decay. Particular importance is attached to the possible hyperdeuteron as the existence of such a particle would be in contradiction to the theory of Gell–Mann as well as allowing one to estimate the strength of the nuclear interaction of the hyperon involved. The main features of the nuclear events are (i) the overall average excitation energy of the evaporation stars is about 150 MeV, (ii) π-mesons are emitted from about 17 percent of the events and most of these, if not all, are negatively charged, (iii) charged hyperons are emitted from a small fraction of the events (one in this case, accompanied by a π-meson), (iv) the mean kinetic energy of the emitted π-mesons is 40 MeV, and (v) the mean prong number of the evaporation stars associated with π-meson emission is significantly greater than the overall average. All these features can be explained qualitatively by one mechanism: the K^--particle enters into the nucleus and then interacts with one nucleon in the presence of other nucleons which take up part of the available energy according to the reaction $K^- + N + \text{nucleons} \rightarrow Y + \pi + \text{nucleons} + Q$. As the primary absorption process occurs fairly near to the nuclear surface, the secondaries from this reaction each have a probability of about 50 percent of escaping without contributing to the nuclear excitation. The hyperons involved appear to be the Λ^0 and the isotopic-spin triplet Σ^+, Σ^0, Σ^-; and the observations require that the production of Λ^0's is of the order of ten times more frequent than that of any particle of the Σ group. A.

539.172

3976. EXCITATION OF NUCLEI BY ABSORPTION OF π^--MESONS. III. A.Tomasini.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 160-8 (Jan., 1956).

For Pt II, see Abstr. 3830 (1954). The results of the two previous parts are revised here. In those papers the authors examine the problem of the excitation of a medium heavy nucleus by a bound π^--meson. They assume that the pion is absorbed by a nucleon pair; the subsequent disintegration is described as a two-step process: a direct emission followed from an evaporation. In the present paper the evaporation process is revised, using a more refined formula. Level densities obtained from disintegration experiments are used; it is shown that the recoil of the nucleus is not negligible in the emission of α-particles; value of level densities differentiated for α-particles and nucleons are used. The results obtained in the case of absorption by a neutron–proton pair are in good agreement with experimental data. It is concluded that the bound π^- are absorbed by neutron–proton pairs; other modes of absorption (by proton–proton pairs or by other nucleon groupings) seem to be quite improbable. A.

539.172.11/.13 : 539.166

3977. GAMMA RAYS FROM THE REACTIONS $Be^9(\alpha, n\gamma)C^{12}$, $C^{13}(d, p\gamma)C^{14}$, $N^{14}(d, p\gamma)N^{15}$ and $N^{14}(d, n\gamma)O^{15}$. R.D.Bent, T.W.Bonner, J.H.McCrary and W.A.Ranken.
Phys. Rev., Vol. 100, No. 3, 771-4 (Nov. 1, 1955).

A magnetic-lens pair spectrometer has been used to study the radiations produced by the bombardment of certain light nuclei with alpha-particles and deuterons from a Van de Graaff accelerator. From the bombardment of Be^9 with 4.3 MeV alpha-particles a single gamma-ray was observe at 4.48 ± 0.06 MeV, Doppler corrected. No 7 MeV nuclear pair line was observed with an intensity as great as 5% that of the 4.48 MeV internal pair line. No 3.2 MeV gamma radiation was observed with an intensity as great as 8% that of the 4.48 MeV gamma-ray. A comparison of the internal and external pair spectra from the $C^{13}(d, p\gamma)C^{14}$ reaction has been made to obtain information on the multipolarities of the 6.1 and 6.7 MeV gamma-rays from C^{14}. If the 6.1 MeV gamma-ray is assumed to be E1, the relative intensities of the 6.1 and 6.7 MeV lines suggest that the 6.7 MeV gamma-ray is E2; however, other multipoles such as E1, M1 and E3 cannot be excluded. A study of the gamma-rays from the reactions $N^{14}(d, p\gamma)N^{15}$ and $N^{14}(d, n\gamma)O^{15}$ shows that the (d, p) cross-section is 2.6 times larger than the (d, n) cross-section at 2.4 MeV bombarding energy, whereas the two cross-sections are about equal at 5.3 MeV bombarding energy. A.

539.172.13

3978. ON THE INELASTIC MEAN FREE PATH OF 450 MeV PROTONS IN NUCLEAR EMULSION. V.Benzi, M.Ladu and N.Marongiu.
Nuovo Cimento (Ser. 10), Vol. 2, No. 6, 1317-19 (Dec , 1955) In Italian.

4079 cm of proton track have been examined in Ilford G5 plates, exposed to a 450 ± 30 MeV proton beam from the Chicago cyclotron. 104 inelastic events have been observed, from which a mean free path of 39.2 ± 4.9 cm is deduced. This differs appreciably from the value (32.7 cm) calculated from the theory of Fernbach, Serber and Taylor, in which the nucleus is treated as a semitransparent sphere of constant density, but is in fairly good agreement with the value (37.4 cm) deduced from Nakano's extension of the theory of Johnson and Teller in which the density is considered uniform only in light nuclei. P.Rothwell

539.172.13

3979. A MEASUREMENT OF THE DIRECTION OF THE POLARIZATION PRODUCED IN THE SCATTERING OF 135 MeV PROTONS. M.J.Brinkworth and B.Rose.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 195-202 (Jan., 1956)

The 135 MeV polarized proton beam, obtained from the Harwell cyclotron by scattering to the left from carbon, has been slowed down to give protons of energy less than 10 MeV, and these protons have then been scattered by helium. The ratio of the intensities scattered at the same angle to left and right of the incident beam has been measured with photographi plates. This ratio, together with a phase shift calculation of the polarization produced in proton–helium scattering, gives the direction of the polarization produced in the first scatterin The observed direction agrees with that predicted theoretically on the assumption that the spin-orbit interaction in high-energ nuclear scattering is the same as in the shell model of the nucleus. A.

539.172.13

3980. INELASTIC SCATTERING OF PROTONS BY Ca^{40}. C.M.Braams.
Phys. Rev., Vol. 101, No. 6, 1764-8 (March 15, 1956).

This was investigated with the MIT-ONR electrostatic generator and a 180 degree magnetic spectrograph. Bombarding energies from 6.54 to 8.15 MeV were used, targets were made of calcium, and the reaction angle was 90 degrees. Exci ed states of Ca^{40} were found at 3.348 ± 0.004, 3.730 ± 0.004, 3.900 ± 0.004, 4.483 ± 0.005, 5.202 ± 0.008. 5.241 ± 0.006, 5.272 ± 0.006, 5.606 ± 0.009, 5.621 ± 0.008. 5.901 ± 0.008 and 6.029 ± 0.008 MeV. A.

539.172.13

3981. EXCITATION FUNCTIONS AND YIELD RATIOS FOR THE ISOMERIC PAIRS $Br^{80,80m}$, $Co^{58,58m}$ AND $Sc^{44,44m}$ FORMED IN (p, pn) REACTIONS. J.W.Meadows, R.M.Diamond and R.A.Sharp.
Phys. Rev., Vol. 102, No. 1, 190-5 (April 1, 1956).

Excitation functions and yield ratios for isomeric pairs have been measured from near threshold to 100 MeV for three (p, pn) reactions. The results are interpreted in terms of the spins of the states involved, the angular momentum of the bombarding particle, competition between compound nucleus formation and the knock-on-mechanism and the level density in excited nuclei as a function of spin. A.

539.172.13

3982. INTERPRETATION OF THE Be^9(p, d) REACTION AT ENERGIES OF 5 TO 30 MeV. S.Glashow and W.Selove.
Phys. Rev., Vol. 102, No. 1, 200-2 (April 1, 1956).

The angular distribution of the Be^9(p, d) reaction is substantially constant between 5 and 30 MeV. The Butler theory, used with a finite radius as cutoff on the radial integral, does not give a satisfactory interpretation of this fact, but the "transparent-nucleus" Born approximation pick-up theory does. For incident energies between 16 and 31 MeV this theory gives a momentum distribution for the picked-up neutron which is consistently defined, and which agrees quantitatively with that obtained from the 95 MeV data; at lower energies, 5 to 8 MeV, the theory does not appear to work quite as well. The results of the analysis give support to the general validity of interpreting results of the high-energy pick-up process in terms of a momentum distribution and a single-particle model. A.

539.172.13 : 537.591.8

3983. TRITIUM PRODUCTION BY HIGH-ENERGY PROTONS. L.A.Currie, W.F.Libby and R.L.Wolfgang.
Phys. Rev., Vol. 101, No. 5, 1557-63 (March 1, 1956).

The cross-sections for tritium production in various substances by 450 MeV and 2.05 BeV protons have been measured. The nitrogen and oxygen cross-sections, 25 ± 4 mb and 30 ± 4 mb respectively at 2.05 BeV, lead to a world-wide average tritium production rate by cosmic rays of $0.14 \, {}_{-0.03}^{+0.10}$ tritons/cm^2sec, in good agreement with the observed value. The iron cross-section, 53 ± 8 mb at 2.05 BeV, suggests a rate of production of 8.8×10^{-4} triton/g sec near the surface of a large meteorite in outer space. For the small Mt. Ayliff iron meteorite an age of 1.4×10^9 years was calculated from the observed He^3 content. Finally, the results for tritium production have been compared to those for other light particles. A.

539.172.13

3984. MAGNETIC SPECTROGRAPH MEASUREMENTS ON THE Al^{27}(d, p)Al^{28} REACTION. W.W.Buechner, M.Mazari and A.Sperduto.
Phys. Rev., Vol. 101, No. 1, 188-95 (Jan. 1, 1956).

A broad-range magnetic spectrograph has been used to study the proton groups from Al^{27}(d, p)Al^{28}. In the region of excitation between the ground state and the neutron binding in Al^{28}, one hundred well-resolved groups were observed and assigned to this reaction on the basis of studies at bombarding energies of 6 and 7 MeV and at several angles of observation. The energy resolution of the proton groups ranged from 800 to 1600. A.

539.172.13

3985. ANGULAR DISTRIBUTIONS OF THE D + D NEUTRONS. P.R.Chagnon and G.E.Owen.
Phys. Rev., Vol. 101, No. 6, 1798-1803 (March 15, 1956).

The angular distributions of the neutrons produced in the D(d, n)He^3 reaction have been investigated experimentally in the deuteron energy range of 0.25 to 0.825 MeV. A two-crystal neutron spectrometer providing discrimination against gamma radiation was used as the detector. It is noted that the experimental data can be fitted by the deuteron stripping theory. A.

539.172.13 : 539.185

3986. A COINCIDENCE ARRANGEMENT FOR THE PRODUCTION OF MONOCHROMATIC NEUTRONS WITH THE (d, d) REACTION. W.Franzen, P.Huber and L.Schellenberg.
Z. Naturforsch., Vol. 10a, No. 11, 820-5 (1955). In German.

It is shown, from an analysis of the dynamics of the reaction, that it is practicable to achieve an energy spread of about 10 keV for those neutrons in coincidence with the He^3 nuclei emitted at 90° to the incident deuteron beam. Exploratory experimental measurements are described. J.Hughes

539.172.13

3987. TRITON-INDUCED REACTIONS. R.Sher and J.J.Floyd.
Phys. Rev., Vol. 102, No. 1, 242 (April 1, 1956).

By using tritons from pile-irradiated Li, the reactions O^{18}(t, n)F^{20}, O^{18}(t, α)N^{17}, and N^{15}(t, p)N^{17} have been observed, and their relative yields obtained. The cross-section at about 2.7 MeV of the well-known reaction O^{16}(t, n)F^{18} was also measured and is roughly 0.5 barn. A.

539.172.3

3988. PHOTODISINTEGRATION OF SAMARIUM. E.Silva and J.Goldemberg.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 12-15 (Jan., 1956).

Disks of pressed Sm_2O_3 were exposed to irradiation by X-rays from a 22 MeV betatron. A.

539.172.3

3989. A COLLECTIVE MODEL FOR THE NUCLEAR PHOTO-REACTIONS. V.de Sabbata and A.Sugie.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 16-32 (Jan., 1956).

For the nuclear photo-reaction in the giant resonance region a collective model was considered which includes both the Goldhaber—Teller and Steinwedel—Jensen type of motion. A coupling of these two modes through the kinetic energy was found, giving a solution with two resonance frequencies. If the higher resonance is identified as the giant resonance, there is better dependence on mass number A of the resonance frequency. But the absolute value of the integrated cross-section is far too small. On the other hand if the lower energy level is taken as the giant resonance, a better A-dependence of the resonance frequency is still obtained, and the absolute value of the integrated cross-section is of the right order of magnitude. But in this case the force constants in the two models must be approximately doubled. A.

539.172.3

3990. PHOTONUCLEAR YIELDS FROM ARSENIC AT 140 MeV AND 320 MeV. T.T.Sugihara and I.Halpern.
Phys. Rev., Vol. 101, No. 6, 1768-71 (March 15, 1956).

Yields of a number of radioactive nuclei produced by synchrotron irradiations of arsenic have been determined at two energies, 140 MeV and 320 MeV. By comparing the yields at both energies to each other and to other data, it is possible to show that the (γ, 3n) and (γ, αn) reactions proceed predominantly by the absorption of a photon to form an excited compound nucleus from which particles are emitted by evaporation. On the other hand, reactions in which more than one charged particle is emitted are often produced by photons having much more energy than would be required for particle evaporation. The average cross-section for the production of a number of such nuclides by photons of energy between 140 and 320 MeV has been measured. For some gallium and copper isotopes the cross-section is as large as a few tenths of a millibarn. A.

539.172.3

3991. THE PHOTODISINTEGRATION OF NITROGEN. I.F.Wright, D.R.O.Morrison, J.M.Reid and J.R.Atkinson.
Proc. Phys. Soc. A, Vol. 69, Pt 2, 77-92 (Feb., 1956).

The (γ, p), (γ, pn), (γ, α), (γ, $\alpha\alpha$) and (γ, αp) reactions in N^{14} have been studied by passing the X-ray beam from a 23 MeV synchrotron through a Wilson cloud chamber. The

range distribution of protons of energy up to 3 MeV shows sharp well-defined peaks at energies of 0.51, 1.63 and 2.92 MeV. These energies correspond closely to the energies of the resonances reported for the $C^{13}(p,\gamma)N^{14}$ (ground state) reaction. For these resonances the ratios of the cross-sections for the (γ,p) and (p,γ) reactions are in good agreement with the predictions of the principle of detailed balancing. At higher energies the following measurements were made: (i) the (γ,p) process was investigated by measuring the range distribution of the C^{13} nuclei, (ii) both (γ,p) and (γ,pn) processes were studied by measuring the numbers of events at three different synchrotron peak energies. The measurements showed that both the (γ,p) and (γ,pn) cross-sections are small at energies up to 15 MeV and large in neighbourhood of 20 MeV. The estimated values of the integrated cross-sections up to 23 MeV for the (γ,p) and the (γ,pn) reactions are both approximately 0.02 MeV barn. The (γ,α), $(\gamma,\alpha\alpha)$ and $(\gamma,\alpha p)$ cross-sections are each about 0.1 millibarn. The implications of these results are discussed in some detail. A.

539.172.4

3992. PROTON POLARIZATION IN (n, p) REACTIONS AND NUCLEAR OPTICAL MODEL. J.Sawicki.
Nuovo Cimento (Ser. 10), Vol. 2, No. 6, 1322-5 (Dec., 1955).

The polarization is calculated by assuming that n, p reactions in the medium energy range are produced by a direct knock-out process, and that the proton on its way out interacts with a spin-dependent potential. No numerical results are given. J.M.Cassels

539.172.4

3993. IONIZATION vs. ENERGY RELATION FOR FISSION FRAGMENTS. H.W.Schmitt and R.B.Leachman.
Phys. Rev., Vol. 102, No. 1, 183-5 (April 1, 1956).

The relation was measured for fission fragments stopped in nitrogen, neon, argon, and argon plus CO_2 (3%). The fission fragments were obtained from thermal-neutron-induced fission of U^{235}. Results of these measurements are consistent with the nuclear recoil effect and show that the ionization produced is not simply proportional to the fragment energy. A.

539.172.4

3994. PREDICTING REACTOR TEMPERATURE EXCURSIONS BY EXTRAPOLATING BORAX DATA. W.K.Luckow and L.C.Widdoes.
Nucleonics, Vol. 14, No. 1, 23-5 (Jan., 1956).

Data on maximum fuel temperature rises for given reactivity increments, obtained from Argonne Borax reactor experiments, has been used to predict fuel temperature transients which might be encountered in a swimming pool reactor as a result of accidental additions of reactivity. The effect of the initial water temperature being below the boiling point is taken into account. The possible influence of forced circulation of the water and the effect of having a graphite reflector instead of water are discussed. L.R.Shepherd

539.172.4

3995. EXAMINING IRRADIATED FUELS UNDER WATER. H.J.Bellarts, J.L.Spencer and R.S.Peterson.
Nucleonics, Vol. 14, No. 1, 30-3 (Jan., 1956).

An underwater facility in which irradiated fuel elements can be inspected, chemically cleaned, and stripped of their cans (also by chemical means), is described. The facility employs relatively simple and inexpensive methods of underwater manipulation. L.R.Shepherd

ATOM AND MOLECULE BEAMS.
MESONS. NEUTRONS 539.18

539.18

3996. CHARGE INDEPENDENCE THEORY OF V PARTICLES. K.Nishijima.
Progr. theor. Phys., Vol. 13, No. 3, 285-304 (March, 1955).

Based on the charge independence hypothesis the properties of V particles are theoretically investigated. It is found that the curious behaviour of these unstable particles is most simply interpreted in terms of the η-charge conservation law which directly results from the charge independence hypothesis and suitable isotopic spin assignments to these particles. The topics which are discussed in this paper are: (a) the isotopic spin assignments to V particles; (b) the concept of the η-charge (c) the η-charge conservation law which is to incorporate with the even–odd rule, the so-called "cascade" decay of some hyperons, and the positive excess of long-lived K particles; (d) the interpretation of heavy nuclear fragments; (e) the possible models of τ-mesons. A.

539.18

3997. MASS DEGENERACY OF THE HEAVY MESONS. T.D.Lee and C.N.Yang.
Phys. Rev., Vol. 102, No. 1, 290-1 (April 1, 1956).

Consequences of the assumption that the θ-τ mass degeneracy is not accidental, but follows from some symmetry principle, are discussed. This assumption implies, among other things, the existence of doublets of opposite parity for all particles of odd strangeness number, such as Λ^0 and $\Sigma^\pm$, Σ^0. A.

539.18

3998. AN ANOMALOUS V^0 EVENT. M.Deutschmann, M.Cresti, W.D.B.Greening, L.Guerriero, A.Loria and G.Zago.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 180-3 (Jan., 1956).

An event has been observed in a multiplate cloud chamber and has the typical aspect of an anomalous V^0 decay: it is compatible with the decay scheme $\tau^0 \rightarrow \pi^+ + \pi^- + \pi^0 + 80$ MeV. A.

539.18

3999. NONMESONIC DECAY OF A HELIUM HYPERFRAGMENT. N.Seeman, M.M.Shapiro and B.Stiller.
Phys. Rev., Vol. 100, No. 5, 1480-4 (Dec. 1, 1955).

In an emulsion stack exposed in an equatorial balloon flight, an event was observed which is most simply interpreted as the disintegration of a He^{4*} hyperfragment according to the scheme $He^{4*} \rightarrow p + d + n + Q$, where $Q = 167.6 \pm 2.9$ MeV. The fragment, emerging from a star of type $11 + 7\alpha$, travelled 633 μ before coming to rest. All the measurements, including those on the fragment track, are consistent with the foregoing decay scheme. Other interpretations are considered and shown to be untenable or very unlikely. From the Q value and the relevant masses, the binding energy of the Λ^0 in the fragment is 1.9 ± 2.9 MeV, in agreement with values from mesonic disintegrations of He^{4*}. This low binding energy may be compared to the much larger value, 20.6 MeV, with which the "last neutron" is bound in normal He^4. A.

539.18

4000. ANOMALOUS V^0 EVENTS AS THREE-BODY DECAYS. J.Ballam, M.Grisaru and S.B.Treiman.
Phys. Rev., Vol. 101, No. 4, 1438-40 (Feb. 15, 1956).

Four possible interpretations of "anomalous" V^0-particle

events which have been observed in cloud-chambers can be made:

(a) $K_{\pi 3}^0 \rightarrow \pi^+ + \pi^- + \pi^0 +$ 80 MeV
(b) $K_{\pi 2}^0 \rightarrow \pi^+ + \pi^- + \gamma +$ 212 MeV
(c) $K_{\mu 3}^0 \rightarrow \mu^\pm + \pi^\mp + \nu +$ 249 MeV
(d) $K_{e3}^0 \rightarrow e^\pm + \pi^\mp + \nu +$ 354 MeV

From the published data 27 events have been extracted which are consistent with at least one of the above decay schemes. The secondary identities are not established for any of these events. Of these 27, 15 are kinematically consistent with (a). Plotting a histogram of the energy, T_0, of the neutral decay product, a phase space distribution is obtained which is not consistent with a spin of $\frac{1}{2}$. If the $K_{\pi 3}^0$ is assumed to be the counterpart of the τ-meson, it is reasonable to suppose a spin of $\frac{1}{2}$. All 27 events have also been analysed in turn on the basis of (b) and (c). The phase space distributions are in good agreement with those predicted. Thus it is tentatively suggested that most of these events can be satisfactorily explained on the basis of (b) and (c) with a small admixture of (d). D.J.Prowse

539.18

4001. HYPERFRAGMENTS AND SLOW K-MESONS IN STARS PRODUCED BY 3-BeV PROTONS. M.Blau.
Phys. Rev., Vol. 102, No. 2, 495-501 (April 15, 1956).

Emission of hyperfragments in 3 BeV proton stars has been investigated. The frequency of hyperfragments per star is 1/1000. Individual events, angular and Z-distribution are discussed. No case of associated production has been found. Five slow K^+ mesons have been found in the same emulsion volume; in 3 cases the secondary could not be identified, one case is probably a $K_{\mu 2}$ decay and one other a $K_{\mu 3}$ decay. One possible case of a K_{e3} meson is also discussed. A.

539.18

4002. THE ENERGY SPECTRUM OF DECAY ELECTRONS OF μ-MESONS IN NUCLEAR EMULSIONS. A.Bonetti, R.L. Setti, M.Panetti, G.Rossi and G.Tomasini.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 33-50 (Jan., 1956). In Italian.

The spectrum was obtained by scattering measurements on 506 tracks. The measurements were made by the coordinate and the angular method; the energies were calculated with the scattering constant of Goldschmidt—Clermont, allowing for variation with velocity and cell-size. The variances on the individual mean angles of scattering were deduced from the Molière—d'Espagnat theory. The experimental spectrum, blurred due to the straggling introduced by bremsstrahlung and the dispersion of the scattering measurements is compared with the theoretical spectra (deduced from the theories of Michel and of Porter and Primakoff) modified to take into account these two effects. The statistical method of "maximum likelihood" has been applied to the estimation of the shape parameter ρ introduced by Michel, referring in the present experiment to a mixture of positive and negative particles ($\rho_\pm$). The result is $\rho_\pm = 0.57 \pm 0.14$, in which the error depends mainly on the uncertainty in the scattering constant and on the fluctuations of frequency of the experimental spectrum. The present value of $\rho_\pm$ is close to those obtained by experimenters making use of other techniques. A.

539.18

4003. HEAVY-MESON DECAYS AND THE SELECTION RULE $|\Delta I| \leq \frac{1}{2}$. G.Wentzel.
Phys. Rev., Vol. 101, No. 3, 1215-16 (Feb. 1, 1956).

It is shown that various features of θ and τ meson decays favour the total isotopic spin selection rule $\Delta I = \pm\frac{1}{2}$.
P.T.Matthews

539.18

4004. DECAY IN FLIGHT OF A NEGATIVE AND A POSITIVE τ MESON. T.L.Aggson, W.B.Fretter, E.W.Friesen, L.F.Hansen, R.G.Kepler and A.Lagarrigue.
Phys. Rev., Vol. 102, No. 1, 243 (April 1, 1956).

Measurements made on two τ-mesons, one positive and one negative, which decayed in flight in a cloud chamber in a magnetic field are given. The Q-value calculated for the positive event is 84 ± 6 MeV and for the negative event is 77 ± 9 MeV. The momentum, energy, and angles of the decay products in the centre-of-mass system are also given. A.

539.18

4005. BINDING ENERGY OF TRITIUM HYPERFRAGMENTS. D.M.Haskin, T.Bowen, R.G.Glasser and M.Schein.
Phys. Rev., Vol. 102, No. 1, 244-6 (April 1, 1956).

Emulsion stacks of Ilford G-5 exposed to π^--meson and K^--meson beams of the Berkeley Bevatron have been scanned for K-meson and hyperon events. An event initiated by a 3.0 BeV π^--meson is described which is interpreted as mesonic decay of a tritium hyperfragment according to the scheme: ${}_1H^{3*} \rightarrow p + p + n + \pi^- + Q$. All of the charged particles from the decay come to rest in the stack. The binding energy of the Λ^0 is found to be 1.4 ± 0.6 MeV. Two additional cases of the same decay scheme are described, one produced in a K^--capture another in a 4.3 BeV π^- star, yielding binding energies $B.E.(\Lambda^0) \leq 1.3 \pm 0.6$ MeV and $B.E.(\Lambda^0) = 3.3 \pm 2.0$ MeV, respectively. A weighted average of these three events gives $B.E.(\Lambda^0) = 1.4 \pm 0.5$ MeV, and of all ${}_1H^{3*}$ events reported, including those found by other workers, $B.E.(\Lambda^0) = 0.5 \pm 0.3$ MeV. A.

539.18

4006. ANGULAR CORRELATION IN CASCADE DECAY. R.Gatto.
Nuovo Cimento (Ser. 10), Vol. 2, No. 4, 841-4 (Oct., 1955).

The conclusions which might be furnished by a study of the angular correlations in the cascade decay: $\Xi^- \rightarrow \Lambda^0 + \pi^-$, $\Lambda^0 \rightarrow p + \pi^-$, on the spin and parities of the Ξ^- and of the Λ^0 are discussed. If the spin of the Λ^0 is $\frac{1}{2}$ the correlation is always isotropic, if it is 3/2, it is of the form, $F(\cos\theta) = 1 + a\cos^2\theta$ and for 5/2 it goes to a $\cos^4\theta$ term. No conclusions as to the relative parities of the Λ^0 and Ξ^- would be possible. The correlation in the cases (3/2 −, 3/2 +) and (3/2 +, 3/2 −) is nearly isotropic. A similar correlation exists between 5/2 −, 5/2 + and higher spins. D.J.Prowse

539.18

4007. ANGULAR DISTRIBUTION OF Λ^0 AND θ^0 DECAYS. R.K.Adair.
Phys. Rev., Vol. 100, No. 5, 1540-1 (Dec. 1, 1955).

Angular correlations of the Λ^0 and θ^0 decays are particularly informative when restricted to particles produced in the forward direction by π^--mesons on protons near threshold.
G.E.Brown

539.18

4008. ANGULAR CORRELATIONS IN ASSOCIATED PRODUCTION. W.D.Walker and W.D.Shephard.
Phys. Rev., Vol. 101, No. 6, 1810-15 (March 15, 1956).

Five examples of associated production have been found in π^--p collisions at 1.0 BeV. Three cases of $\Lambda^0 + \theta^0$, one case of $\Sigma^0 + \theta^0$ and one case of $\Sigma^- + K^+$ have been found. From these cases a cross-section of about 1 mb is deduced. The centre-of-mass angular distribution of the hyperons is compared with that found by W.B.Fowler et al. at 1.4 BeV. The hyperons show a strong correlation between their decay planes and their planes of production as has been found previously by Fowler et al. The θ^0's do not show this tendency. The possibilities of observational bias are considered. One explanation of these phenomena is that the orbital angular momentum vector and spin vector of the hyperon are either parallel or antiparallel. From these and other considerations it seems likely that the spin of the hyperons Σ and Λ^0 is 3/2 or 5/2 or possibly as high as 7/2 and the spin of the θ^0 is probably 0 but could be 1. A.

539.18

4009. THE MASSES OF POSITIVE K-PARTICLES. H.H.Heckman, F.M.Smith and W.H.Barkas.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 85-93 (Jan., 1956).

A programme of measuring meson masses is extended to the positive τ, $K_{\mu 2}$, $K_{\pi 2}$, $K_{\mu 3}$ and τ'-particles. With the Bevatron as a source, and employing a modification of the Kerth–Stork quadrupole lens and analysing-magnet arrangement, the authors have obtained a mass resolution of 1.6% for an individual particle. Using the stopping behaviour or the grain density of the secondary for K-particle classification, and the multiple scattering as a check, they obtained practically pure samples of the above types of K-mesons for analysis. The particles were compared directly with protons of the same momentum, and also with the τ-meson, the mass of which is known accurately. Relative to the mean τ mass of 966 m_e they obtain the following results, all in electron mass units: τ (966 ± 3.1), $K_{\mu 2}$ (962.5 ± 3.2), $K_{\pi 2}$ (972.2 ± 4.7), $K_{\mu 3}$ (951.2 ± 10.6), τ' (951.1 ± 10.9). These are all consistent with a single K mass of 966. The results are independent of the range–momentum relation; however, the intercomparison of the masses measured relative to the τ-meson and relative to the proton check closely, indicating that there are no large systematic errors and that the shape of the range–momentum relation must be nearly correct. A.

539.18

4010. RATIO OF K^- MASS TO K^+ MASS. F.H.Webb, W.W.Chupp, G.Goldhaber and S.Goldhaber.
Phys. Rev., Vol. 101, No. 3, 1212-14 (Feb. 1, 1956).

A stack of emulsions was exposed to the Berkeley Bevatron focused K^+ beam and another stack to the K^- beam obtained by reversing the polarity of the analysing magnet (see Abstr. 9122/1955). Passing through the same momentum channel (~ 300 MeV) pions have minimum ionization in the stacks. Tracks with grain densities corresponding to 700 - 1300 me were scanned. In order to improve the accuracy of mass determination for K^- the momentum channel was calibrated as follows. Adopting $M_{K^+} = M_\tau = 965.4\ m_e$ the K^+-range was used for precision determination of the positive channel. The momentum of the negative channel was determined by means of the pions. These were stopped by a copper absorber with pellicles inserted in a wedge cut. If the momentum of the positive channel is known, that of the negative channel can be found from the π^+ and π^- range difference. The range and momentum of 42 K^- tracks were used and the ratio obtained was $M_{K^-}/M_{K^+} = 0.998 \pm 0.013$ for K-mesons present after a time of flight of 1.4×10^{-8} sec in their proper system. H.Motz

539.18

4011. ON THE SPIN AND PARITY OF THE τ-MESON. G.Costa and L.Taffara.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 169-79 (Jan., 1956).

The angular distributions of the secondaries of the τ-meson have been calculated for eight combinations of spin and parity, using the hypothesis accepted until now about the type of interaction. Comparing these distributions with the experimental data, one finds a satisfactory agreement for the cases of even spin and odd parity, especially for the [0, −] case. A.

539.18

4012. METHOD FOR DETERMINING SPINS OF HYPERONS. S.B.Treiman.
Phys. Rev., Vol. 101, No. 3, 1216-17 (Feb. 1, 1956).

By studying angular correlations in the decay of hyperons produced in the capture of negative K-mesons by protons, one can determine the spins of the Λ^0 and Σ hyperons. G.E.Brown

539.18

4013. SPIN OF THE Λ^0 PARTICLE. M.Ruderman and R.Karplus.
Phys. Rev., Vol. 102, No. 1, 247-50 (April 1, 1956).

An analysis of the mesonic and nonmesonic decay of hyperfragments shows that the spin of the Λ^0 particle is 1/2 or 3/2. If the spin is 3/2, the parity is that of the proton. A.

539.18

4014. ON PION–NUCLEON SCATTERING. E.Clementel and C.Villi.
Nuovo Cimento (Ser. 10), Vol. 2, No. 4, 845-9 (Oct., 1955).

An analytical method for the calculation of the pion–nucleon phase shifts outlined in a previous paper (Abstr. 9962/1955) has been reformulated for negative elastic and charge-exchange scattering. A mechanical analyser for the determination of phase shifts is described. G.E.Brown

539.18

4015. SCATTERING OF 22-MeV POSITIVE PIONS BY PROTONS. S.L.Whetstone, Jr and D.H.Stork.
Phys. Rev., Vol. 102, No. 1, 251-61 (April 1, 1956).

The differential cross-section for the reaction $\pi^+ + p \rightarrow \pi^+ + p$ was measured in the angular interval 45^0 to 135^0 in the centre-of-mass system at a pion energy of 21.5 ± 3.5 MeV in the laboratory system. The pion beam was formed by a magnetic-focusing selection of pions produced from polyethylene at an angle of 0^0 in the reaction $p + p \rightarrow \pi^+ + d$. The production target was placed in the strong-focused 340 MeV proton beam electrostatically deflected from the Berkeley synchrocyclotron. The pion beam entered liquid hydrogen contained in a styrofoam scattering target at 25.0 MeV, with an energy spread of ± 0.6 MeV, and left at 18.0 MeV. Scattered pions were detected in an emulsion stack placed 1 in. from the beam edge and $\frac{7}{8}$ in. from the liquid hydrogen. The data, consisting of 41 acceptable events, were analysed by a maximum-likelihood method to obtain the following best values for the pion-proton scattering phase-shifts at a relative momentum, $\eta = 0.49$: $\alpha_3 = -0.048 \pm 0.007$, $\alpha_{33} = +0.013 \pm 0.013$, $\alpha_{31} = 0.000 \pm 0.016$. A.

539.18

4016. DOUBLE SCATTERING OF PSEUDOSCALAR MESONS. A.H.Barrass.
Proc. Roy. Irish Acad. A, Vol. 57, No. 8, 137-49 (1955).

The probability of the process $\pi^- + P \rightarrow N + \pi^- + \pi^+$ is discussed in charged theory with pseudoscalar coupling, using conventional perturbation theory. With a coupling constant $g^2/\hbar c = 4$, there is at non-relativistic energies less than 0.4% of the double as compared with the single process. J.S.Bell

539.18 : 537.531

4017. PROPORTIONAL COUNTER MEASUREMENTS OF π-MESONIC X-RAYS FROM BERYLLIUM. D.West and E.F.Bradley.
Phil. Mag. (Ser. 8), Vol. 1, 97-100 (Jan., 1956).

The use of proportional counters in the study of π-mesonic X-rays improves the energy resolution obtainable by scintillation counters by nearly a factor of 6. Measurements on beryllium using the π^--meson beam from the Liverpool synchrocyclotron give a value for the K_α (2p - 1s) energy of 41.76 ± 0.20 keV. This is less than that calculated neglecting nuclear force effects. A nuclear force shift is therefore definitely established for beryllium. D.J.Prowse

539.18 : 530.145

4018. THE RELATIONSHIP BETWEEN THE STATISTICAL AND FIELD THEORETICAL TREATMENTS OF MULTIPLE MESON PRODUCTION. Y. Takahashi.
Canad. J. Phys., Vol. 34, No. 4, 378-80 (April, 1956).

539.18

4019. HEAVY UNSTABLE PARTICLES PRODUCED IN THE HIGH ENERGY PION BEAM OF THE BERKELEY BEVATRON. M.Schein, D.M.Haskin and R.G.Glasser.
Nuovo Cimento (Ser. 10), Vol. 3, No. 1, 131-40 (Jan., 1956).

Stacks of 600 μm pellicles were exposed to the 4.6 and 3.0 GeV pion beam of the Berkeley Bevatron. A number of heavy unstable particles and hyperfragments were obtained. The ratio of the frequency of occurrence of K^+ and K^--mesons has been found to be approximately unity in contrast to the

large positive excess in the proton beam. As a possible explanation, it is suggested that the K^--meson is produced in conjunction with a K^+-meson according to the following reaction: $\pi^- + p - K^+ + K^- + N$. Two hyperfragment decays of hydrogen have been found in which the π^--meson stops. One of the hyperfragments was identified as a ${}_1H^{4*}$ produced by a Σ^--hyperon; the other one is a ${}_1H^{3*}$ produced directly by the high-energy pion. The range of all the charged particles was accurately determined which yielded a reliable value of the binding energy. The value of the binding energy (B.E.) for ${}_1H^{3*}$ was found to be 1.2 ± 0.6 and for ${}_1H^{4*}$ B.E.$(\Lambda^0) = 3.3 \pm 1$. The mean free path for nuclear collisions was determined for 5.7 GeV protons and 3 GeV π^--mesons. The results yielded for protons 37.6 ± 5.3 cm and for π^--mesons 35.5 ± 5.0 cm. Both mean free paths are longer than the geometrical mean free path for nuclear collisions in the emulsion, which is 25 cm.
A.

539.18

4020. HEAVY-MESON FLUXES AT THE COSMOTRON. G.Harris, J.Orear and S.Taylor.
Phys. Rev., Vol. 101, No. 3, 1214-15 (Feb. 1, 1956).

Measurements were made of the π/K and K/τ ratios in a momentum-analysed K-meson beam of the Cosmotron. The π/K ratio was 90 compared with 20 in the Bevatron while the K/τ was the same as the Bevatron figure within statistical error.
A.J.Egginton

539.18

4021. ON THE POSSIBILITY OF PRODUCTION OF Λ^0-PARTICLES BY PROTONS OF ENERGY UP TO 700 MeV. M.P.Balandin, B.D.Balashov, V.A.Zhukov, B.M.Pontekorvo (Pontecorvo) and G.I.Selivanov.
Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 265-73 (1955). In Russian.

An attempt to observe the creation of Λ^0-particles in collisions of 670 MeV protons with carbon nuclei gives a limit on the cross-section of $\sigma_{\Lambda 0}$ of 10^{-31} cm^2/nucleon or under. In principle the experiment allows the observation of γ-rays coming from π^0-mesons in the decay $\Lambda^0 \rightarrow n + \pi^0$. A γ-ray detector consisting of a telescope of two scintillation and two Cherenkov counters is employed, and γ-rays arising from direct π^0 production and decay in the target are collimated out. No positive evidence of Λ_0-production is found. Hence, in nucleon—nucleon collisions, $N + N \rightarrow \Lambda^0 + N$ does not occur with appreciable probability.
G.E.Brown

539.185

4022. ON THE SCATTERING OF A NEUTRON BY AN ATOM OF HYDROGEN. P.N.Roussopoulos.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 473-4 (Jan. 23, 1956). In French.

The motion of the proton in the hydrogen atom, which is caused by the motion of the electron, modifies the n,p scattering at large angles and high energies.
J.M.Cassels

539.185

4023. ABSOLUTE CALIBRATION OF THE NATIONAL BUREAU OF STANDARDS PHOTONEUTRON STANDARD. I. J.A.De Juren, D.W.Padgett and L.F.Curtiss.
J. Res. Nat. Bur. Stand., Vol. 55, No. 2, 63-9 (Aug., 1955).

The absolute emission rate of neutrons from the National Bureau of Standards radium-beryllium photoneutron standard source has been determined from the volume integral of the neutron absorption rate in water. Thin indium and manganese foils were employed to measure the thermal-neutron density as a function of distance from the source. The foil activities were converted to neutron densities by calibration of the foils in a reference thermal-neutron flux previously calibrated with boron films. A motor driven mechanical integrator, which moves foils radially from the source at a rate that takes into account the increase in area with distance from the source and the decay of the foils, provided over 80% of the volume integral. A value of $1.26_5 \times 10^6$ neutrons per sec was determined for the emission rate of the photoneutron standard, with an estimated standard error of 3%.
A.

539.185

4024. TRITIUM GAS TARGET FOR NEUTRON PRODUCTION. C.H.Johnson and H.E.Banta.
Rev. sci. Instrum., Vol. 27, No. 3, 132-4 (March, 1956).

Reports a self-contained tritium gas target including beam collimator, target cell, and gas reservoir which has been used for the production of neutrons from the T(d, n)He^4 and T(p, n)He^3 reactions. Beam collimators are 0.14 in. tantalum apertures aligned in precision 1 in. tubing to assure accurate beam measurement. The gas cell is $\frac{5}{16}$ in. dia. and may be any length less than 3 in. The target window is a 0.000 05 in. nickel foil soldered on a $\frac{1}{4}$-in. i.d. re-entrant tube. Tritium is supplied from a uranium tritide oven; hydrogen-tritium exchange is minimized by the use of nonhydrogenous materials. A discussion is given of handling of tritium. The target will tolerate a 1 μA beam of 2 MeV deuterons for several days without foil damage.
A.

539.185.08

4025. FISSION CHAMBER MEASURES NEUTRON DISTRIBUTION QUICKLY, ACCURATELY. R.G.Nobles and A.B. Smith.
Nucleonics, Vol. 14, No. 1, 60-62 (Jan., 1956)

The construction and pulse-height characteristics of a small fission chamber are described.
L.R.Shepherd

539.185.08

4026. A NEUTRON SPECTROMETER USED AT THE SACLAY PILE. M.Galula, B.Jacrot and F.Netter.
Onde élect., Vol. 35, 818-20 (Oct., 1955). In French.

Describes a time-of-flight instrument using a mechanical chopper and capable of working up to 100 eV. The results presented comprise a spectrum of the neutron beam and the total cross-section of Pu^{239} as a function of neutron energy.
J.M.Cassels

539.185.08

4027. A NEUTRON DETECTION METHOD TO BE USED WITH PULSE ACCELERATORS. F.Ferrero, R.Malvano and C.Tribuno.
Nuovo Cimento (Ser. 10), Vol. 2, No. 5, 1135-6 (Nov., 1955).

A betatron duty cycle of 0.1% with a long off period (20 msec) allows detection of β-active Rh^{104} following neutron capture in a 0.7 g/cm^2 Rh^{103} foil, and gives a non-energy-sensitive method (few keV to 4.5 MeV) of measuring a pulsed neutron flux without a background of short-lived (γ, n) etc. activities. The method is compared with the more usual one of measuring total activity after a definite irradiation.
D.R.Chick

539.185.08

4028. HIGH-ENERGY NEUTRON DETECTORS EMPLOYING LIQUID SCINTILLATORS. E.R.Christie, B.T.Feld, A.C.Odian, P.C.Stein and A.Wattenberg.
Rev. sci. Instrum., Vol. 27, No. 3, 127-31 (March, 1956).

Two liquid scintillation type neutron detectors with efficiencies of the order of 5% for counting 130 MeV neutrons have been studied. A fairly monoenergetic source of neutrons was obtained from the photodisintegration of deuterons. Estimates were made of the efficiencies of the counters as a function of bias. Experiments indicate: (1) an appreciable effect of the products of neutron reactions with carbon; (2) the efficiency can be more accurately predicted for a small counter although the behaviour of large counters can be qualitatively predicted; (3) the attenuation due to a lead shield in the beam depends upon the neutron energy, the bias, and the geometry; (4) lead shielding on the sides is relatively unimportant if kept thin.
A.

539.185.7

4029. DETERMINATION OF THE TRANSPORT MEAN FREE

PATH OF THERMAL NEUTRONS BY MEASUREMENT OF A COMPLEX DIFFUSION LENGTH. V.Raievski and J.Horowitz. Onde élect., Vol. 35, 821-32 (Oct., 1955). In French.

The transport mean free path can be determined by studying the amplitude and phase of the slow neutron density oscillations when the primary neutron source is modulated at various frequencies. The theory of the method is given and experimental work on graphite and heavy water is described in detail. The same technique could be used to measure slowing-down lengths, or the absolute capture cross-section of boron for slow neutrons. J.M.Cassels

539.185.7 : 536.48

4030. TRANSMISSION OF SLOW NEUTRONS BY LIQUID He^4. II. L.Goldstein and H.S.Sommers, Jr. Phys. Rev., Vol. 101, No. 4, 1235-42 (Feb. 15, 1956).

For Pt I, see Abstr. 4109 (1955). The Los Alamos slow-neutron total scattering cross-sections in liquid He^4 are analysed using the general scattering theory expected to be valid at short and medium neutron wavelengths. With the approximate mean kinetic energies and partial mean square forces per liquid atom derived previously, the theory is in fair agreement with the data below about 8 A; it breaks down at longer wavelengths. The analysis of the data is then inverted by attempting to solve the following problem: it is possible to find with the cross-section data a set of liquid parameters, at a given liquid temperature, such that the cross-sections computed with them would represent the data at wavelengths larger than 8-9 A. This problem receives an affirmative solution inasmuch as the neutron data liquid parameters turn out to be in fair agreement with the approximate liquid parameters obtained by an entirely different method. The scattering cross-sections recalculated with the new parameters represent the data fairly well out to 12-13 A. A direct, practically experimental, proof has been obtained for the existence of a very large zero-point kinetic energy in liquid He^4 over a wide temperature interval. The significance of these results for the derivation, with neutron and X-ray data, of mean kinetic and potential energies, and mean square forces, per atom, in liquids is discussed. A.

STRUCTURE OF SOLIDS 539.2

539.21 : 539.164

4031. BOMBARDMENT OF GLASS BY ALPHA-PARTICLES. D.G.Tuck. Nature (London), Vol. 177, 434-5 (March 3, 1956).

A study of the rate of leaching of soda and Pyrex glass surface after they have been bombarded by about 10^{14} α-particles. cm^{-2}; the bombardment increases the initial rate, due — presumably — to some "breakdown" in the surface. R.O.Davies

539.21 : 539.185.9

4032. STUDY OF THE MACROSCOPIC GROWTH OF GRAPHITE UNDER IRRADIATION. J.L.Delcroix and J.Yvon. C.R. Acad. Sci. (Paris), Vol. 242, No. 5, 628-30 (Jan. 30, 1956). In French.

The Wigner expansions of two samples of extruded graphite, irradiated at 30° C in the Saclay pile for up to 4000 MWh, were measured mechanically. The results indicate expansion rates of 1% and 1.6% per 10^{21} fast neutrons per cm^3, parallel and perpendicular respectively to the extrusion direction. R.S.Pease

539.21 : 539.185.9

4033. RADIATION DAMAGE IN VITREOUS SILICA: ANNEALING OF THE DENSITY CHANGES. W.Primak and H.Szymanski. Phys. Rev., Vol. 101, No. 4, 1268-71 (Feb. 15, 1956).

The kinetics of annealing of the nuclear reactor radiation-induced change in density of a sample of irradiated vitreous silica was studied by means of a series of isothermal annealin performed at various temperatures. The property change wa found to anneal gradually over a broad range of temperatures suggesting a range of activation energies for annealing. A

539.213.1

4034. DERIVATION OF THE W.L.F. EQUATION FOR THE MOBILITY OF MOLECULES IN MOLTEN GLASSES. F.Buech J. chem. Phys., Vol. 24, No. 2, 418-19 (Feb., 1956).

A previous theory for the mobility of molecules in glasses near the glass temperature (Abstr. 1775/1954) has been extend ed in an effort to deduce the semiempirical relation proposed by Williams, Landel, and Ferry (Abstr. 10019/1955). By focus ing attention upon the free volume, one is able to derive their relation in a straightforward fashion subject to approximations valid near the glass temperature. The interpretation of the con stants which WLF proposed for their relation is shown to be correct. A

539.217

4035. SELF-DIFFUSION AND CONDUCTIVITY IN SILVER CHLORIDE. W.D.Compton. Phys. Rev., Vol. 101, No. 3, 1209-10 (Feb. 1, 1956).

Differences as large as 1.25 are observed between the radioactive tracer diffusion coefficient of Ag^+ ions (using Ag^{110} isotope) and the Einstein coefficient from conductivity data. Using the Cl^{36} isotope the diffusion coefficient is found to be 10^{-3} of that for silver ions. G.F.J.Garlick

539.217

4036. RATIO OF IONIC CONDUCTIVITY TO TRACER DIFFUSION IN INTERSTITIALCY MIGRATION. C.W.McCombie and A.B.Lidiard. Phys. Rev., Vol. 101, No. 3, 1210-11 (Feb. 1, 1956).

Shows that a value of the ratio about 3 times as large as the Einstein value is to be expected on the basis of the "interstitialcy" mechanism of Koch and Wagner. Application is made to experimental results for AgCl. E.P.Wohlfarth

539.217 : 539.16.08

4037. THE DIFFUSION OF CHROMIUM IN TITANIUM STUDIED BY AN AUTORADIOGRAPHIC METHOD. A.J.Mortlock and D.H.Tomlin. Proc. Phys. Soc. B, Vol. 69, Pt 2, 248-50 (Feb., 1956).

Diffusion sandwiches were formed by evaporating Cr containing Cr^{51} on to one finely ground face of each of two small specimens of Ti; the faces are then clamped together. An autoradiograph was taken of the surface of this composite specimen perpendicular to the interface. The specimen was annealed the surface ground down about 2 mm, and another autoradiograph taken. This procedure was repeated several times, and the images on the autoradiographs scanned by a microphotometer. The method makes it possible to study the dependence of the diffusion coefficient on any factors which may change during the anneal (such as grain size). A.J.Kennedy

539.217 : 539.16.08

4038. A COMPARISON OF THREE RADIOACTIVE TRACER METHODS FOR STUDYING THE DIFFUSION OF CHROMIUM IN TITANIUM. A.J.Mortlock and D.H.Tomlin. Proc. Phys. Soc. B, Vol. 69, Pt 2, 250-2 (Feb., 1956).

The values obtained by the method described in the preceding abstract are compared with those obtained by liquid and surface counting techniques. These agree very closely. A.J.Kennedy

539.219

4039. AN INVESTIGATION OF THE SODIUM–POTASSIUM EQUILIBRIUM DIAGRAM. D.K.C.MacDonald, W.B.Pearson and L.T.Towle. Canad. J. Phys., Vol. 34, No. 4, 389-94 (April, 1956).

The study of fundamental properties such as specific heat d electrical resistivity in pure metals has made it very nportant to know the influence of small amounts of impurity. his has led the authors to undertake a detailed investigation the sodium—potassium equilibrium diagram. Previous work d indicated zero solid solubility at each limit (100% Na; 0% K) but the present investigation shows in particular that olubility extends to a few per cent from either limit. A.

539.234

040. ANOMALOUS INTERPLANAR SPACINGS IN EVAPOR-TED DEPOSITS OF FACE-CENTRED CUBIC METALS. .I.Garrod.
roc. Phys. Soc. B, Vol. 69, Pt 2, 260-3 (Feb., 1956).

Considers previous results of spacing measurements, ade on thin metallic films by electron diffraction, in the ght of an analysis of the effects of stresses and stacking ults respectively. The observed anomalies are shown to be redominantly of the growth type. The metals concerned are opper, silver and gold. J.Thewlis

539.24 : 539.27

041. A SIMPLE APPARATUS FOR THE STATISTICAL VALUATION OF PHOTOGRAPHS IN MICROSCOPY OR ELEC-RON MICROSCOPY. F.Endter and H.Gebauer.
ptik, Vol. 13, No. 3, 97-101 (1956). In German.

An apparatus is described that assists an operator to ecord the particle size distribution in, for example, a micro-notograph of a dispersion of small particles. A light spot hose diameter may be varied by the operator is manually djusted to coincide with each particle in turn, thus determin-g the approximate particle size and position. This information automatically recorded by a bank of telephone registers. It claimed that a thousand points an hour can be registered in is way. A pen system automatically marks the particles as ey are measured. A.E.I.Research Laboratory

539.27

042. SUMMARIZED PROCEEDINGS OF A CONFERENCE N ELECTRON MICROSCOPY—GLASGOW, JULY, 1955. .E.Challice.
rit. J. appl. Phys., Vol. 7, No. 3, 89-93 (March, 1956).

Brief summaries are given of papers read at the annual nference of the Electron Microscopy Group of the Institute Physics. Subjects include: Electron optics and instrument-ion; Chemical applications; Metallurgical applications; Bio-gical applications.

ELASTICITY. STRENGTH. RHEOLOGY 539.3/.8

539.32

43. ELASTIC CONSTANTS OF INDIUM ANTIMONIDE. H.deVaux and F.A.Pizzarello.
ys. Rev., Vol. 102, No. 2, 85 (April 1, 1956).

By means of an acoustical method, the elastic constants of is compound were measured. At room temperature they are: $_1 = (6.6 \pm 0.3) \times 10^{11}$, $C_{12} = (3.8 \pm 0.2) \times 10^{11}$, $C_{44} = (3.0 \pm 0.1) \times 10^{11}$ dynes/cm^2. A.

539.32 : 536.228.1 : 548.73

44. STUDY OF PIEZOELECTRIC VIBRATIONS OF UARTZ BY X-RAY DIFFRACTION. R.Mermod.
elv. phys. Acta, Vol. 28, No. 5-6, 543-62 (1955). In rench.

Curves are given of the intensity of X-rays diffracted by X-cut quartz crystal plate when static or when vibrating different amplitudes. When vibrating, the intensity was eater and, as the order of diffraction increased, the inten-ty curves became more asymmetrical. The results suggest at the elastic modulus of quartz increases under compression. theoretical explanation of the results is attempted in terms of a mosaic hypothesis which seems capable of explaining the phenomenon of ageing in quartz clocks and the existence of half-odd and even resonances observed for X-cut quartz. H.J.H.Starks

539.373 : 534.23 : 548.7

4045. MASON'S DISLOCATION RELAXATION MECHANISM. J.Weertman.
Phys. Rev., Vol. 101, No. 4, 1429-30 (Feb. 15, 1956).

Suggests that Mason's model (Abstr. 7438, 7786/1955) probably gives rise to an internal friction peak which occurs at a lower temperature than those observed by Bordoni. This will occur if the dislocation segment does not move from one equilibrium position to the other as a whole but by a kinked segment which then expands into a longer segment. W.Bardsley

539.373 : 534.23 : 548.7

4046. COMMENTS ON WEERTMAN'S DISLOCATION RELAXATION MECHANISM. W.P.Mason.
Phys. Rev., Vol. 101, No. 4, 1430-1 (Feb. 15, 1956).

Considers that Weertman's suggestion that small loops are produced at low temperatures is valid but that it can be shown that these do not grow into larger loops at any temperatures of interest and contribute very little to the attenuation except at low temperatures. Hence Weertman's criticism is not considered to be valid. W.Bardsley

539.374

4047. DELAY TIME OF PLASTIC FLOW IN GERMANIUM. J.R.Patel.
Phys. Rev., Vol. 101, No. 4, 1436-7 (Feb. 15, 1956).

In recent experiments the effect of delay time was reinvestigated to determine its effects on the stress—strain curves. Using the equation $\tau = \tau_0 \exp(Q/RT)$ after Seitz, it is found that $\tau_0 = 3 \times 10^{-10}$ sec and $Q = 39\,000$ cal/mole. The impurity acting as a Cottrell atmosphere is thought to be copper. W.Bardsley

539.375

4048. DEFORMATION CHARACTERISTICS OF HAFNIUM. D.S.Eppelsheimer and D.S.Gould.
Nature (London), Vol. 177, 241-2 (Feb. 4, 1956).

A total deformation by cold rolling of about 30% appears to be the maximum obtainable before cracking occurs, although at elevated temperatures (500° C) no such limit was observed. The compression texture was found to be [0001] rotated 15° - 30° from the compression axis. The rolling texture is very similar. The twinning and slip modes which could account for such a texture are noted. A.J.Kennedy

539.42 : 548.0

4049. THE TENSILE PROPERTIES OF SINGLE CRYSTALS OF HIGH-PURITY IRON AT TEMPERATURES FROM 100 TO −253° C. N.P.Allen, B.E.Hopkins and J.E.McLennan.
Proc. Roy. Soc. A, Vol. 234, 221-46 (Feb. 7, 1956).

An account is given of the deformation and fracture characteristics of single crystals of high-purity iron of various orientations when tested in tension at temperatures from 100 to −253° C. At temperatures down to −124° C, the crystals were fully ductile, giving chisel-edge fractures and 100% reduction in area. At −196° C, depending on the orientation of the stress axis, the behaviour covered the whole range from fully ductile with 100% reduction in area to completely brittle with cleavage fractures and no apparent deformation. Between these limits, mixtures of slip, twinning and cleavage were obtained. At −253° C, the crystals gave cleavage fractures, and, over most of the orientation range studied, this occurred without prior deformation. It is shown that the resolved shear stresses required to produce slip or twinning at −196° C vary with the orientation; in particular, the values are higher for orientations within 20 to 25° of the [001] than elsewhere in the unit triangle, and these values are not reached in this region before failure occurs by cleavage. A mechanism is put forward to explain this in terms of "locking" of dislocations. The

cleavage strength resolved normal to the cleavage plane is not constant with change in temperature, as is commonly supposed, but is substantially higher at −253° C than at −196° C A.

539.434 : 548.7

4050. RELATIONSHIP BETWEEN SMALL-ANGLE DISLOCATION BOUNDARIES AND CREEP. B.Ancker, T.H.Hazlett and E.R.Parker.
J. appl. Phys., Vol. 27, No. 4, 333-41 (April, 1956).

Small-angle dislocation boundaries of controlled nature (sharp or diffuse) and density were introduced (by prestraining at room temperature and annealing at 800° C) into high-purity polycrystalline nickel prior to creep at 700° C. By this method, the shape of the creep curve was varied drastically. The initial density of small-angle boundaries ranged from an average of nearly zero per grain, to a large number which was limited by the occurrence of recrystallization. X-ray microscopic examination showed that the dislocation networks developed during creep were nearly identical and were independent of the initial density and nature. The density of small-angle boundaries developed during creep is also independent of the creep strain within the limits of 1% and 7.5%, the str at which the most ductile specimens fractured. The near ide tity of the substructure developed during creep was further verified by the substantial equality of the specimens' tensile strengths after creep. The only detectable difference in the substructures was an increase of the average boundary angle with increasing total strain. The type of substructure unique developed during high-temperature deformation is discussed in terms of dislocation climb and the interaction of local str fields from climbing dislocations with those in piled-up arra

539.6

4051. ON THE EFFECT OF SPEED ON THE KINETIC FR TION OF SOME PLASTIC MATERIALS ON ICE. C.D.Niven, Canad. J. Phys., Vol. 34, No. 4, 362-9 (April, 1956).

Curves are shown illustrating the effect of speed on the friction of Teflon, Bakelite, Nylon, Terylene, Plexiglas, Pe pex), cellulose acetate, polystyrene, and polyethylene, slidi on ice at −5° C. and −15° C. Bakelite and Teflon had the lowe kinetic friction of the materials examined. Terylene also sli easily but polyethylene had rather high friction. Departure from Amontons' Law was very evident at high speed.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.11 : 537.561

4052. USE OF MASS SPECTROMETRIC APPEARANCE POTENTIALS IN THERMOCHEMICAL CALCULATIONS. I. CONSISTENCY RELATIONSHIPS FOR METHANE AND SUBSTITUTED METHANES, AND THE HEAT OF FORMATION OF CH_3F. J.L.Margrave.
J. chem. Phys., Vol. 24, No. 2, 475-6 (Feb., 1956).

Develops a subtraction method to be used for similar fragmentation reactions and their corresponding appearance potentials in order to obtain heats of reaction to be compared with calorimetric data or used for calculation of unknown thermochemical quantities. The heats of reactions $CH_4 + X \rightarrow CH_3X + H$ (where X is a halogen, OH, CN, or NO_2, or nothing) obtained by this method from mass-spectrometric data agree well with those obtained from heats of formation. The calculated value for the heat of formation of CH_3F is -59 ± 2 kcal/mole for $D(F_2) = 36.6$ kcal/mole. F.Lachman

541.11 : 537.561

4053. USE OF MASS SPECTROMETRIC APPEARANCE POTENTIALS IN THERMOCHEMICAL CALCULATIONS. II. CHLOROFLUOROMETHANES AND THE DISSOCIATION ENERGY OF FLUORINE. J.L.Margrave.
J. chem. Phys., Vol. 24, No. 2, 476-7 (Feb., 1956).

The subtraction method derived in Pt I is applied for calculating the dissociation energy of F_2 from appearance potentials of chlorofluoromethanes. A whole series of values ranging from −34 to 180 kcal/mole are obtained. The probable causes of discrepancies between most of these figures and the recent direct determinations are discussed. F.Lachman

541.124

4054. SELECTIVE OXIDATION OF SILVER-MAGNESIUM ALLOYS IN WATER VAPOR M.Hirashima.
J. appl. Phys., Vol. 27, No. 1, 95-6 (Jan., 1956).

Notes on an experimental study of the process. MgO only is formed on the alloy surface owing to the great difference in dissociation pressure. The activation energy of the rate-determining process, believed to be the diffusion of Mg thro MgO, was 20.7 kcal.mole. A.H.W.Be

541.12

4055. HYDROGEN-BROMINE REACTION IN A NONSTEAI STATE. D.Britton and N.Davidson.
J. chem. Phys., Vol. 23, No. 12, 2461 (Dec., 1955).

Presents results of a preliminary investigation of the H/Br reaction when a shock wave was used to rapidly heat an $A-H_2-Br_2$ mixture to 1000-1500° K (for the experimental technique see Abstr. 5007/1955). It was found that the exper mental values of k_3 (from equation $-d(Br_2)/dt = k_3(Br)(H_2)$ fo the reaction $Br + H_2 \leftrightarrow HBr + H$) are $\sim 1/3$ of k_3 obtained by calculation [$k_3 = 4.56 \times 10^8 T^{\frac{1}{2}} \exp(-18\,780/RT)$]. Other result confirm an unpublished finding that Br_2 is not much more effective than A as the medium (M) in reactions $M + Br_2 \leftrightarrow M + Br + Br$. F.Lachma

541.12

4056. THERMAL DECOMPOSITION OF NITROGEN DIOXIDE. W.A.Rosser, Jr and H.Wise.
J. chem. Phys., Vol. 24, No. 2, 493-4 (Feb., 1956).

It is found to be second order with respect to NO_2 in the range 630° to 1000° K and 10^{-8} to 10^{-7} mole per cm^3 and to have an activation energy of 26 to 27 kcal. It is unaffected by the presence of N_2, He, or CO_2 at pressures up to one atmosphere and by the extent of surface in the vessel. W.Goo

541.1

4057. RELATIVE RATES OF ISOMERIZATION OF CYCLO PROPANE AND CYCLOPROPANE-t_1. R.H.Lindquist and G.K.Rollefson.
J. chem. Phys., Vol. 24, No. 4, 725-31 (April, 1956).

The relative rates of isomerization of cyclopropane and monotritiated cyclopropane have been determined in the tem perature range of 447° to 555° C. The ratio of the rate constants for the two reactions can be fitted by the equation: $k/k' = 0.63 \pm 0.02 \exp(825 \pm 60/RT)$. The marked increase i the temperature-independent term upon tritium substitution discussed in terms of Slater's unimolecular reaction rate

eory and Eyring's absolute reaction rate theory. The pos-
ility of classical vibration coupling causing the observed
fect is suggested. A.

541.127

58. KINETIC STUDY OF THE REACTION OF DIBORANE TH PHOSPHINE. H.Brumberger and R.A.Marcus.
chem. Phys., Vol. 24, No. 4, 741-6 (April, 1956).

The homogeneous gas phase reaction between diborane and osphine at 0°C, yielding a solid product of composition H_3PH_3, has been observed to give a linear relation between e initial rate of reaction and the pressure of either reactant, ovided a certain pressure of each reactant, determined by e equilibrium constant and the pressure of the other gas, is ceeded. The reaction rate is independent of the amount of rface of the solid product or of the wall. When either reagent in appreciable excess, the rate-time data obey a pseudo st-order equation. These facts are consistent with a rate-ntrolling reaction of diborane with phosphine to give BH_3PH_3 d BH_3, the borine reacting further with phosphine, and the H_3PH_3 condensing rapidly to a solid. This mechanism leads to ate equation which is in good agreement with the experimen- evidence. The activation energy of the rate-controlling step 11.4 ± 2.0 kcal mole^{-1}. A.

541.127 : 530.162

59. ELECTRODIFFUSION: A FLUCTUATION METHOD OR MEASURING REACTION RATES. K.J.Mysels.
chem. Phys., Vol. 24, No. 2, 371-5 (Feb., 1956).

A new approach to the problem of measuring rapid ionic actions is proposed. It is based on the fact that if a dynamic uilibrium system involves a species changing between two nic forms at a rapid rate, the times spent by the individual rticles in the two forms fluctuate randomly. In an electric eld this produces a random walk corresponding to an elec- ically induced diffusion coefficient. The extent of this electro- ffusion is correlated with the rate of the reaction. It is shown at in principle it is feasible to measure reaction rates down half-lives of the order of ten milliseconds, and that the use alternating current, and particularly of reversing direct rrent, offers distinct advantages. A.

541.127.4

960. SPECTROPHOTOMETRIC STUDY OF THE LIQUID-HASE EQUILIBRIUM $N_2O_4 \rightleftharpoons 2NO_2$ IN PURE NITROGEN ETROXIDE. C.M.Steese and A.G.Whittaker.
chem. Phys., Vol. 24, No. 4, 776-9 (April, 1956).

The liquid-phase equilibrium constants for the reaction $_2O_4 \rightleftharpoons 2NO_2$ in pure nitrogen tetroxide were measured over e normal liquid range of the substance. The NO_2 concentra- on in the liquid was determined by comparing its light sorption in the liquid with the absorption of a known concen- ation in the vapour. The results gave a linear relation be- een log equilibrium constant, and the reciprocal of the solute temperature. An average heat of dissociation of N_2O_4 the liquid phase of 19.5 kcal/mole was obtained. A.

541.127.4 : 538.224

961. MAGNETIC SUSCEPTIBILITY STUDY OF THE LIQUID HASE EQUILIBRIUM $N_2O_4 \rightleftharpoons 2NO_2$ IN PURE NITROGEN ETROXIDE. A.G.Whittaker.
chem. Phys., Vol. 24, No. 4, 780-3 (April, 1956).

The magnetic susceptibility of liquid nitrogen tetroxide as measured by the Gouy method over the temperature range C to 30°C. The liquid was found to be diamagnetic through- t this temperature range although the diamagnetism de- eased as the temperature increased. The magnetic measure- ents were found to be in good agreement with the spectro- otometrically determined equilibrium composition of the quid as reported in the preceding abstract. A.

ELECTROCHEMISTRY 541.13

541.132

4062. PROTON CONDUCTANCE AND THE EXISTENCE OF THE H_3O^+ ION. B.E.Conway, J.O'M Bockris and H.Linton.
J. chem. Phys., Vol. 24, No. 4, 834-50 (April, 1956).

Measurements of the conductance of HCl in water, methanol, ethanol, n-propanol, ethylene glycol, glycerol, 1 : 4 dioxane, acetone, formic and acetic acids and the respective aqueous-nonaqueous systems have been made as a function of concentration of water and HCl. The degree of anomalous proton conductance decreases with increasing n in $C_nH_{2n+1}OH$, and conductance minima occur in aqueous alcoholic HCl solutions of low H_2O content. Former theories of proton conductance have permitted no quantitative distinction to be made between the rates of classical proton transfer, quantum-mechanical tunneling transfer, and water rotation as rate determining stages. If resonance in H_3O^+ is set up sufficiently quickly after arrival of a given proton at a water molecule, rotation of H_3O^+ cannot be a rate determining step. Detailed calculations of the rates of classical proton transfer, tunnel transfer and the rate of rotation of water are made. Classical transfer is much slower and tunnel transfer much faster than corresponds to the observed proton mobility; rotation of hydrogen bonded water molecules near the H_3O^+ ion is the rate determining reaction (preceded and succeeded by fast tunneling of protons). This conclusion is quantitatively consistent with the OH^- mobility in water, and the H^+/D^+ mobility ratio and qualitatively consistent with pressure and temperature effects and with the absence of abnormal mobility of NH_4^+ and NH_2^- in liquid NH_3. A detailed interpretation of the dependence of abnormal conductance upon chain length in ROH gives fair quantitative agreement with experiment. The conductance minima observed in aqueous alcoholic HCl are quasi-quantitatively predicted by the theory. The proton spends about 1% of its time undergoing tunnel transfers; the effective existence of the H_3O^+ ion is thus confirmed. A.

541.135.5

4063. KINETICS OF ACTIVATION CONTROLLED CONSECUTIVE ELECTROCHEMICAL REACTIONS: ANODIC EVOLUTION OF OXYGEN. J.O'M.Bockris.
J. chem. Phys., Vol. 24, No. 4, 817-27 (April, 1956).

The kinetics of activation controlled electrode reactions differ from those of chemical kinetics by the potential dependence of the rate constant of a step involving charge transfer and the constancy of concentration of reactants in the initial state. A method is proposed whereby an expression for the kinetics of an electrode reaction containing any number of intermediate steps may be obtained. The method is applied to five paths for the electrolytic evolution of oxygen at anodes and yields limiting expressions for the dependence of the current density (or rate) of the reaction upon electrode potential which are diagnostic of the various rate controlling steps assumed. If discharge of OH^- or H_2O molecules is rate determining, the Tafel slope is $2RT/F$ at overpotentials > 50 mV. If some other reaction involving charge transfer is rate determining, two possible Tafel slopes, each independent of potential in its range of applicability, occur, depending upon degree of coverage of the electrode with intermediate products. If a reaction involving no charge transfer is rate determining, a number of Tafel slopes is indicated, each characteristic of the rate controlling reaction, and an activation controlled limiting current density is possible. Quantitative conditions for change of mechanism with current density are evaluated. For the initial reaction of a consecutive series to be rate determining it suffices that the rate constant for the backward partial reaction of this step be limitingly small compared with other rate constants in the series; for the last reaction to be rate controlling, the rate constant of its forward partial reaction must be limitingly small; for any other reaction in the series, both

backward and forward rate constants of the rate determining reaction must be limitingly small. The rate of the anodic oxygen evolution reaction as a function of pH is evaluated, taking into account concentration and foreign electrolyte effects on the electrokinetic potential at the electrode-solution interface. The results enable the discharging entity in solution to be distinguished. Former data are reinterpreted from the criteria of mechanism deduced. A.

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.14

4064. NOTE ON THE THEORY OF DIFFUSION CONTROLLED REACTIONS: APPLICATION TO PHOTODISSOCIATION IN SOLUTION. L.Monchick.
J. chem. Phys., Vol. 24, No. 2, 381-5 (Feb., 1956).

The theory of diffusion-controlled reactions has been reconsidered in the light of modern transport theory, and it has been concluded that the use of the Smoluchowski equation is valid for most problems of usual interest. The probability of reaction has been calculated for two molecules initially separated by a distance r', in the presence of a third reactant present in uniform concentration. The resulting formulae have been used to discuss the quantum yields of photodissociation of Br_2, Br_3^- and I_3^- in aqueous solution. The dependence on temperature and wavelength can be qualitatively accounted for. A.

541.14

4065. PHOTOLYSIS OF ETHANE AT 1470 A.
M.H.J.Wijnen.
J. chem. Phys., Vol.24, No. 4, 851-4 (April, 1956).

The photolysis of ethane at 1470 A has been investigated in the temperature range 25° to 240° C and over a wide range of initial ethane pressures. As reaction products were found mainly H_2, CH_4, C_3H_8 and C_4H_{10}. Traces of ethylene and, not identified, higher hydrocarbons were also detected. The results indicate that the primary step in the photolysis of ethane is $C_2H_6 + h\nu \rightarrow C_2H_5 + H$. The amounts and ratios of products, formed during the photolysis, indicate that the reaction mechanism of the photolysis is similar to that of the Hg photosensitized decomposition of ethane. A few experiments on the photolysis of CO_2 at 1470 A indicate that φCO increases with increasing temperatures. A.

541.14

4066. ISOTOPIC EFFECTS AND COLLISIONAL DEACTIVATION IN THE MERCURY PHOTOSENSITIZED DECOMPOSITION OF ETHYLENE. A.B.Callear and R.J.Cvetanović.
J. chem. Phys., Vol. 24, No. 4, 873-8 (April, 1956).

Mercury photosensitized decomposition of C_2H_4, C_2D_4, cis-$C_2D_2H_2$ and C_2H_4 with excess xenon added, has been investigated at room temperature. An isotopic effect in the intramolecular decomposition of ethylene has been established, as well as an extensive isotopic isomerization in the course of collisional deactivation of the energy rich molecules. The cis-dideuteroethylene isomerizes not only to the trans- but also to the anti-form. The experimental results are discussed in terms of the intramolecular decomposition and collisional deactivation of the excited molecules formed in the primary process. A.

541.15 : 548.7

4067. THE BEHAVIOUR OF γ-RECOIL ATOMS IN SOLID SUBSTANCES. W.Buser and P.Graf.
Helv. phys. Acta, Vol. 28, No. 5-6, 458-60 (1955). In German.

The relations between the yields of recoil atoms and recoil and lattice energies in the irradiation of MnO, β-MnO_2, CoO and ZnO with slow neutrons are summarized in tabular form and their significance discussed. W.Good

541.183.022

4068. MONOLAYERS OF LINEAR MACROMOLECULES. H.L.Frisch and R.Simha.
J. chem. Phys., Vol. 24, No. 4, 652-5 (April, 1956).

A model is proposed for monolayers composed of linear macromolecules, particularly at an oil/water interface. If the polymer at the interface is sufficiently flexible, the layer will consist of anchored portions connected by bridges of segments lying out of the plane in which the anchored segments are deposited. An equation of state for the monolayer is derived and its limiting form is compared with those due to Singer and Bul The limiting form of the equation of state seems to be in satisfactory agreement with some published experimental data. The results suggest the possibility of obtaining rough indications of the shape and mean dimensions of the macromolecule at the interface from film studies at both the air/water and oil/water interface. Finally the application of this model to explain the apparent dissociation of protein monolayers is indicated. A

541.183.26

4069. STATE OF NITROGEN ADSORBED ON TUNGSTEN. II. G.Ehrlich.
J. chem. Phys., Vol. 24, No. 2, 482 (Feb., 1956).

Evidence is adduced for the existence of a third (γ) adsorbed state with a heat of adsorption below 10 kcal. $mole^{-1}$, in addition to the α and β states previously postulated (Abstr. 771/1956). S.J.Gregg

CHEMICAL STRUCTURE 541.2/.6

541.64

4070. SOLUTION OF A CHARACTERISTIC VALUE PROBLEM FROM THE THEORY OF CHAIN MOLECULES. B.H.Zimm, G.M.Roe and L.F.Epstein.
J. chem. Phys., Vol. 24, No. 2, 279-80 (Feb., 1956).

An eigenvalue problem encountered in the dynamical theory of chain molecules is

$$\int_{-1}^{1} \alpha''(s)(|r - s|)^{-1/2} ds = -\lambda\alpha(r); \quad \alpha'(\pm 1) = 0.$$

This is solved by three methods: use of a Fourier series for α, expansion of α in associated Legendre polynomials P_m^2, and by a variation method. The eight smallest eigenvalues are calculated explicitly and an approximate formula is found for the remaining one. Formulae are found also for the eigen functions. A.

CHEMICAL ANALYSIS 543/545

545 37

4071. DEVICES FOR AUTOMATIC POTENTIOMETRIC TITRATION. R.Audran and D.T.R.Dighton.
J. sci. Instrum., Vol. 33, No. 3, 92-5 (March, 1956).

Two devices capable of automatically performing titration are described. Both control an electromagnetically operated burette tap from the output of a suitable electrode. The first device, which uses an electronic valve amplifier, is adaptable to any tritration the end point of which can be determined potentiometrically. The second, which makes use of a sensitiv relay, is only suitable where the electrode used has a low internal resistance. A

545.8 : 539.17

4072. ANALYSIS OF LIGHT ELEMENTS BY THE UTILIZATION OF THE NUCLEAR REACTIONS d, n AND d, α. P.Süe
C.R. Acad. Sci. (Paris), Vol. 242, No. 6, 770-1 (Feb. 6,

956). In French.

The n, γ reaction of elements with low Z leads often to sotopes with either too long or too short half lives for ctivation analysis. In such cases d, n or d, α reactions may e useful. A number of different samples of dry salts were xposed to the deuterium flux of a cyclotron. The induced adioactivity was measured either directly or for P^{30}, Cl^{34} nd K^{38} after chemical separation. The doses were monitored ith K^{42}. The reaction d, n allowed the estimation of B, O and in quantities of 1 μg (0.5 μg for B), whereas the reaction , α was useful for the estimation of S. Ca could not be esti- nated in low concentrations. M.Ebert

545.82

4073. GAS ANALYSIS BY NON-DISPERSIVE INFRARED ABSORPTION. K.F.Luft.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 482-4 (Jan. 23, 1956). In French.

A refinement of the original Luft method suitable for estimating a gas (a) whose absorption band overlaps with those of impurities. The detector consists of two different length gas tubes in series containing (a) and connected respectively to the opposite sides of a condenser vane. G.F.Lothian

545.822

4074. SPECTROCHEMICAL ANALYSIS WITH TIME-RESOLVED SPARK SPECTRA. Á.Bardócz and F.Varsányi.
Nature (London), Vol. 177, 222-3 (Feb. 4, 1956).

The accuracy of analysis is usually limited by background continuum from initial stages of the spark discharge. A system of synchronized rotating mirror and electronically controlled spark is described. The spectrum of the later part of the spark is recorded separately and shows a striking reduction in background and increase in sensitivity. A.G.Gaydon

CRYSTALLOGRAPHY 548

548.5

4075. ORIENTED OVERGROWTH OF EVAPORATED CRYSTALLITES. FLUORIDE CRYSTALLITES ON CLEAVAGE SURFACES OF SINGLE CRYSTALS. J.Shigeta.
J. Phys. Soc. Japan, Vol. 11, No. 3, 206-10 (March, 1956).

The orientation of crystallites in fluoride films (LiF, NaF, CaF_2, MgF_2, AlF_3 and Na_3AlF_6) evaporated in vacuum on to the cleavage surfaces of several kinds of single crystals (galena, rock salt, molybdenite and zinc blende) were investigated by means of electron diffraction. The oriented overgrowth occurs even when the misfit is larger than 20%; for LiF and NaF on galena misfits are −33% and −23% respectively, for LiF on rock salt misfit is −29% and for CaF_2 on molybdenite +23%. On the other hand, for CaF_2 on rock salt random orientation occurs though the misfit is only −3%. Therefore the occurrence of orientation can not be predicted solely by the value of misfit. It is worth mentioning that in the present experiment no twin was observed provided the evaporated layer is thin, as previously stated by Uyeda. This excludes the mechanism of oriented overgrowth which was proposed by Menzer (1938) and later adopted by Frank and Merwe (1949). A.

548.5 : 536.7

4076. THE THERMODYNAMICS OF CRYSTAL NUCLEI. I.Kaishev.
Izv. Bulg. Akad. Nauk, Vol. 4, 85-92 (1954, publ. 1955). In Bulgarian with summary (1 p.) in German.

See also Abstr. 3986 (1954). Treats thermodynamics of formation of new lattice planes on the faces of a crystal. Gibbs–Wulff's rule is derived for the case of two-dimensional crystals. Energy for reversible isothermal formation of 2-dimensional complexes of equilibrium form on various crystal faces in calculated in relation to supersaturation of mother phase. This energy has a maximum for a given supersaturation, when referred to the increase of the linear dimensions of the complex. The ratio of the formation energy of any given complex with equilibrium form to the energy of nucleation may be expressed by the ratio of the corresponding centre distances referred to any crystallographic edge of the 2-dimensional complex. B.F.Kraus

548.574

4077. OBSERVATIONS ON ETCHED CRYSTALS OF BARIUM TITANATE. D.S.Campbell.
Phil. Mag., Vol. 46, 1261-2 (Nov., 1955).

Crystals of $BaTiO_3$ direct from the melt were etched with hydrochloric and phosphoric acids. (100) and positive and negative (001) limits to the domains could be separately identified. Observation of wedges (8 photographs reproduced) shows almost perfect head to tail ordering of domains up to 0.07 mm. A.L.Mackay

ATOMIC AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

4078. EFFECT OF DEFECTS ON LATTICE VIBRATIONS: INTERACTION OF DEFECTS AND AN ANALOGY WITH MESON PAIR THEORY. E.W.Montroll and R.B.Potts.
Phys. Rev., Vol. 102, No. 1, 72-84 (April 1, 1956).

An analysis is given of the determination of additive functions of the frequencies of the normal mode vibrations of a lattice. The method is applied to the problem of calculating the self-energies and interaction energies of defects in lattices of any dimension. In particular results are derived for the self-energies and interaction energies of isotopes, holes, and "source" defects in simple cubic monatomic and diatomic lattices. For example it is shown that two holes in a simple cubic lattice attract each other, the energy of interaction being inversely proportional to the cube of the distance of separation. The general method is also applied to the problem of the interaction of lattice defects with the boundaries of the lattice. Finally, if the lattice approaches the limit of a continuum, it is shown that the energy of interaction between two holes is just that obtained by Wentzel for the interaction between two fixed nucleons according to the scalar meson pair theory. A.

548.7

4079. THE NATURE OF THE THERMAL AGITATION IN CRYSTALS. C.V.Raman.
Proc. Indian Acad. Sci. A, Vol. 42, No. 4, 163-74 (Oct., 1955).

The principles of thermodynamics and of the quantum theory indicate that the thermal energy in a crystal is identifiable with the energy of an immense number of atomic oscillators which have their frequencies of vibration in common but are in different states of excitation. Dynamical investigation of the problem shows that if the crystal contains p interpenetrating Bravais lattices of atoms, there are (24 p−3) frequencies of vibration common to all oscillators. An investigation of the propagation of waves in crystal lattices shows that the results of of the classical theory of elasticity are valid only in the limiting case of very low frequencies and proves further that the group velocity of the waves vanishes for (24 p−3) frequencies which may accordingly be identified as the characteristic frequencies of atomic vibration in the crystal. Since there is no wave-

propagation in the real or physical sense except in the very lowest range of frequencies, the identification of the thermal energy with the energy of waves traversing the crystal in all directions, and having frequencies all different from one another, which forms the basis of the specific heat theory of Debye and of Born's lattice dynamics, ceases to be justifiable. Other aspects of these latter theories are also examined and it is shown that the assumptions which they involve are untenable and that in consequence the theories have no claim to validity. The experimental results which confirm that the atomic oscillators have specific frequencies in common and modes of vibration specifically related to the crystal structure are briefly set out. A.

548.7

4080. PRINCIPAL LATTICE FREQUENCY OF MgO. B.D.Saksena and S.Viswanathan.
Proc. Phys. Soc. B, Vol. 69, Pt 2, 129-38 (Feb., 1956).

The principal lattice frequency has been obtained at 25.26 μ from the observed dispersion in the region 0.36-5 μ. This frequency and the frequencies of the longitudinal and transverse modes of vibration of (1,0,0) and (1,1,1) planes against each other have been calculated on the Born model. Reflection coefficients and refractive indices have been calculated, in good agreement with observed data, on the usual dispersion formula and that of Blackman. The lattice frequency lies at 25.1 μ in absorption and at 22 μ in reflection, the reflection curve between 17 and 22 μ being flat. The reflection maximum at 16 μ is interpreted as a combination frequency. A.

548.7 : 536.7

4081. ON THE THERMODYNAMICS OF CRYSTALLINE LATTICES. L.Salter.
Proc. Roy. Soc. A, Vol. 233, 418-27 (Dec. 29, 1955).

The thermodynamic functions for an ideal crystalline lattice satisfying the Born cyclic boundary conditions are formulated in terms of phase-space averages of functions of the trace of the dynamical matrix. An approximate method of evaluating these averages is suggested, which takes on an especially simple form in the case of lattices with cubic symmetry. The general theory is applied to the case of the monatomic face-centred cubic lattice and used to determine the five microscopic force constants occurring in the dynamical matrix for aluminium. These are computed from experimental data on the elastic constants and high-temperature behaviour of the specific heat and calorimetric entropy. A.

548.7

4082. IMPURITY LEVELS IN CRYSTALS (HYDROGEN MODEL). D.Curie.
J. Phys. Radium, Vol. 17, No. 1, 16-20 (Jan., 1956). In French.

The influence of crystal anisotropy and variation of dielectric constant with frequency on the Bethe model of localized levels is investigated. The anisotropy produces elliptical electron orbitals due to the dependence of effective mass on axial direction, the eccentricity being large for small difference in mass but requiring a large change in mass for energy levels to be displaced appreciably. G.F.J.Garlick

548.7

4083. ENERGY BAND STRUCTURES OF THE CARBORUNDUM SiC CRYSTAL. S.Kobayasi.
J. Phys. Soc. Japan, Vol. 11, No. 2, 175-6 (Feb., 1956).

A report of preliminary calculations of the band structure by using the Bloch tight-binding approximation.

G.F.J.Garlick

548.7

4084. EMPIRICAL RELATIONSHIP BETWEEN THE EXCITATION ENERGY OF THE F-BAND PHYSICAL CONSTANTS FOR ALKALI HALIDES. M.Levy.
Nature (London), Vol. 177, 241 (Feb. 4, 1956).

548.7

4085. MULTIPLET STRUCTURE OF EXCITONS IN IONIC CRYSTALS. A.W.Overhauser.
Phys. Rev., Vol. 101, No. 6, 1702-12 (March 15, 1956).

The excited states of crystals arising from the configuration in which an electron is transferred from a negative ion to a nearest neighbour positive ion are analysed. It is concluded that 72 overlapping exciton bands result for crystals having the NaCl structure. Optical transitions from the ground state are allowed to only 5 of the 30 energy levels into which the 72 bands collapse at the centre of the Brillouin zone. For crystals having the CsCl structure, 96 bands occur which collapse into 40 energy levels at k = 0, 6 of which can be reached from the ground state by allowed optical dipole transitions. In the absence of spin-orbit interaction, only two transitions are allowed for both structures. It is concluded that the lifetime of exciton states, as limited by interaction with optical phonons, is sufficiently short to account for the width and temperature dependence of fundamental absorption lines. Approximate wave-functions describing the exciton states are constructed and a procedure for calculating energy levels and relative intensities of absorption components is formulated. A.

548.7

4086. INTERACTIONS OF EXCITONS WITH LATTICE VIBRATIONS IN POLAR CRYSTALS. I. GENERAL THEORY. H.J.G.Meyer.
Physica, Vol. 22, No. 2, 109-20 (Feb., 1956).

A theory describing slow excitons which interact with longitudinal optical lattice vibrations is developed within the framework of the effective mass approximation. In many respects the theory is very similar to — and makes explicit use of — the ordinary theory of polarons which is used here in Gurari's formulation. Interesting differences with polaron theory are introduced by the fact that an exciton has an internal degree of freedom and is as a whole electrically neutral. Therefore the coupling to the lattice vibrations is less than that of a simple point charge and depends on the wave-function of the internal motion and on the ratio of the effective masses of the two particles composing the exciton. In fact, the coupling is zero if these two masses are equal. As regards optical transitions of excitons to the ground state of the crystal it is demonstrated how the possibility for these transitions is determined by the properties of the wave-function of the relative motion in combination with those of the Bloch functions of the valence- and the conduction band. Finally a general expression for the probability of such a transition with the simultaneous emission of some phonons is derived. A.

548.7

4087. ELECTRONIC BAND STRUCTURE OF DIAMONDS. J.J.Brophy.
Physica, Vol. 22, No. 3, 156-8 (March, 1956).

Reviews the known properties and method of classification of diamonds and suggests that the difference between diamonds showing different properties is merely one of impurity type and concentration and that the present classification into types I, IIa and IIb while convenient, is somewhat arbitrary, and may account for some controversies in the literature.

C.A.Hogarth

548.7

4088. NUCLEAR MAGNETIC RESONANCE EXPERIMENT ON THE SINGLE CRYSTAL OF LITHIUM SULFATE MONOHYDRATE, $Li_2SO_4.H_2O$. E.Hirahara and M.Murakami.
J. Phys. Soc. Japan, Vol. 11, No. 3, 239-44 (March, 1956).

Proton magnetic resonance absorption of water molecules in the single crystal of $Li_2SO_4.H_2O$ was observed, and the length and directions of the proton—proton line (p—p) of the water of crystallization were determined. The results obtained are as follows: there are two kinds of orientations of the p—p line in the unit cell, which contains two molecules of $Li_2SO_4.H_2O$, and they are symmetrically disposed with respect to the ac-plane.

the plane of mirror, making angles $\pm 51^0$ to that plane. The angle between the projection of each p—p line on the ac-plane and the positive direction of the a-axis is 94^0, and the length of p—p line is 1.59 A. From the results obtained and crystal structure by X-ray analysis, the bond angle of H—O—H is expected to lie between $106^0 50'$ and $112^0 40'$, and presumably some value nearer to $112^0 40'$ may be taken to be favourable from the consideration of the bonding character. The single crystals were prepared by a slow evaporation method from an aqueous solution in a water bath at 80^0 C. A.

548.7

4089. INFLUENCE OF ULTRASONIC ENERGY ON THE RELAXATION OF CHLORINE NUCLEI IN SODIUM CHLORATE. W.G.Proctor and W.H.Tanttila.
Phys. Rev., Vol. 101, No. 6, 1757-63 (March 15, 1956).

An investigation of the direct and indirect thermal relaxation processes of Cl^{35} in a single crystal of $NaClO_3$ has been made by using pulsed techniques. The temperature dependence of the indirect process has been measured at four temperatures ranging between room temperature and liquid nitrogen temperature. The experimental results are in good agreement with the theoretical results of Chang. The direct process has been studied by introducing into the crystal ultrasonic energy at a frequency equal to the transition frequency between the two quadrupolar energy levels of the Cl^{35} nucleus. The agreement between the theoretical dependence of the direct-process relaxation time as a function of the energy density of the transition-frequency lattice vibrations is poor. The experiment, as done, has the basic weakness that the calculated energy density of the introduced lattice vibrations is a function of the phonon relaxation time, T_p, a quantity only poorly known in the most favourable cases. A different method for making the same type of study independent of the phonon relaxation time is discussed. A.

548.7

4090. PHOTOGRAPHS OF THE STRESS FIELD AROUND EDGE DISLOCATIONS. W.L.Bond and J.Andrus.
Phys. Rev., Vol. 101, No. 3, 1211 (Feb. 1, 1956).

Results are shown for silicon crystals using wavelengths in the near infrared. H.G.Jerrard

548.7

4091. DISLOCATIONS, RELAXATIONS, AND ANELASTICITY OF CRYSTAL QUARTZ. H.E.Bömmel, W.P.Mason and A.W.Warner.
Phys. Rev., Vol. 102, No. 1, 64-71 (April 1, 1956).

By careful grinding and etching, contouring and mounting in a vacuum, very small internal friction coefficients Q^{-1} are found in AT shear vibrating crystals. Various tests show that the internal friction corresponds to that of the quartz itself. The internal friction at room temperature increases proportionally to the frequency up to 100 Mc/s indicating the presence of relaxations. These have been investigated by measuring the internal friction at very temperatures down to 1.5^0K and two relaxations were found. One having a time constant of 10^{-13} sec appears to be connected with a distorted lattice due to impurities while the other having a time constant of 7.7×10^{-10} sec is thought to be connected with dislocation loops. Using equations developed previously for metals the indicated number of dislocations is $N \cong 10^8/cm^2$, the average loop length about 1.8×10^{-3} cm and the ratio of Peierls force to shear modulus about 5×10^{-8}. Confirmation of these values is given by the time constant 7.7×10^{-10} sec and the change in frequency as a function of amplitude. A long-time ageing effect is thought to be due to closer pinning of dislocations by impurity atoms. It is suggested that an improved frequency standard, free from ageing, can be obtained by holding the temperature of the crystal at liquid helium temperature. A.

548.7 : 666

4092. COLOUR CENTRES IN METAPHOSPHATE GLASS. J.H.Schulman; S.Basu.
Nature (London), Vol. 177, 287 (Feb. 11, 1956).

The author corrects some misreadings of his conclusions on X-ray induced coloration in metaphosphate glasses made by Basu (Abstr. 9242/1955) and restates that coloration is not dependent on activation processes due to metallic components of the glass. Basu explains that he had seen only abstracts of Schulman's papers, and comments further on his results. G.F.J.Garlick

548.7 : 535.371

4093. STORAGE OF ENERGY IN BERYLLIUM OXIDE. H.O.Albrecht and C.E.Mandeville.
Phys. Rev., Vol. 101, No. 4, 1250-2 (Feb. 15, 1956).

The photostimulated ultraviolet emission of X-ray excited BeO has been measured as a function of the wavelength of the incident light. A maximum of emission occurs for a stimulating wavelength of ~ 4100 A. Experiments are described which are interpreted as showing the presence of doubly occupied traps in BeO which are analogous to the F-centres of the alkali halides. Some discussion concerning energy storage in NaCl(Ag) is included. A.

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.73

4094. ERRORS IN THE A.S.T.M. INDEX OF X-RAY POWDER DIFFRACTION PATTERNS. J.W.Hughes, I.E.Lewis and A.J.C.Wilson.
Brit. J. appl. Phys., Vol. 7, No. 2, 80 (Feb., 1956).
J. sci. Instrum., Vol. 33, No. 2, 86 (Feb., 1956).

An analysis of the errors which have so far been notified, and a note on discrepancies in intensity between photographic data and counter-diffractometer data. A.R.Stokes

548.733

4095. A VERSATILE X-RAY DIFFRACTOMETER FOR SINGLE-CRYSTAL AND POWDER STUDIES. A.R.Lang.
J. sci. Instrum., Vol. 33, No. 4, 138-41 (April, 1956).

A robustly constructed instrument is described which can be adapted to a wide variety of diffraction techniques. Specimen axis and counter arm are independently rotatable, manually or automatically, and are both carried by opposed tapered roller bearings. Following a predetermined programme, spectrum scanning may be performed at two speeds: slowly at angles of interest, and fast elsewhere. Graphical recorder indication of diffracted intensity can be made independent of X-ray output fluctuations by using a potentiometer reference voltage proportional to X-ray tube current. A.

548.733

4096. X-RAY DIFFRACTION DATA FROM RADIOACTIVE MATERIALS. R.S.Pease.
Rev. sci. Instrum., Vol. 26, No. 12, 1204 (Dec., 1955).

Describes how fogging of the X-ray film by a beta-active powder specimen can be very substantially reduced by applying a magnetic field of 5000 gauss around the specimen; and further by using a small specimen and a fine-focus X-ray source. A.R.Stokes

548.733

4097. DOUBLE-CRYSTAL SPECTROMETER ATTACHMENT TO THE WIDE-RANGE GONIOMETER OF THE NORELCO X-RAY DIFFRACTOMETER. S.R.Maloof.
Rev. sci. Instrum., Vol. 27, No. 3, 146-7 (March, 1956).

The outstanding features of the design are: (1) the axes of rotation of both crystals are made parallel in the construction of the instrument; (2) one can easily align the instrument in the parallel (n, −n) or antiparallel (n, +n) setting in less than one hour; and (3) no modification of the Norelco equipment is needed, and good use is made of the wide-range goniometer for setting the first crystal at the proper Bragg angle for re-

flection. Typical parallel position rocking curves for single-crystal germanium and silicon are presented. A.

548.733

4098. IMPROVED MONOCHROMATOR FOR DIFFUSE X-RAY SCATTERING MEASUREMENTS. D.R.Chipman.
Rev. sci. Instrum., Vol. 27, No. 3, 164-5 (March, 1956).

A close approximation to a doubly bent crystal monochromator is obtained by pressing a large number of narrow strips in a doubly concave form. Details of construction are given. For measurements of diffuse scattering from a single crystal the monochromator gives 40 times the intensity of a singly bent crystal for the same volume element in reciprocal space. A.

548.733 : 537.542

THE DESIGN AND PERFORMANCE OF X-RAY PROPORTIONAL COUNTERS. See Abstr. 2958

548.734

4099. POLARIZATION CORRECTION FOR CRYSTAL-MONOCHROMATIZED X-RADIATION. L.V.Azaroff.
Acta cryst., Vol. 8, Pt 11, 701-4 (Nov., 1955).

The polarization correction for diffraction of a crystal-monochromatized X-ray beam is derived. Suitable expressions for different experimental methods are also given. The polarization correction is first tabulated in parts so that the appropriate correction for any wavelength and monochromator crystal can be determined. Another table lists selected values of the polarization correction, in a final form, for different wavelength X-radiations reflected from (10$\bar{1}$1) planes of a quartz monochromator. The maximum correction for Ag Kα is a little more than 1%, whereas for Cr Kα the maximum correction is 34%. A.

548.734

4100. A NEW TYPE OF X-RAY DIFFRACTION PICTURE (HIGH-VOLTAGE LAUE PHOTOGRAPHS). H.S.Peiser and J.R.Rait.
Acta cryst., Vol. 8, Pt 11, 738 (Nov., 1955)

A collimated pencil of "white" X-rays falls on the specimen, which absorbs all radiation under 90 kV. The diffraction pattern shows streaks, which can be used for measuring grain size and stress inside thick specimens. C.Turner

548.735

4101. THE ANISOTROPIC TEMPERATURE FACTOR IN TRICLINIC COORDINATES. J.Waser.
Acta cryst., Vol. 8, Pt 11, 731 (Nov., 1955)

A simpler and more direct version of the derivation given by Rollett and Davies (Abstr. 4194/1955) of the relation between the temperature factor of an atom and its mean square displacement in any direction. A.R.Stokes

548.735

4102. LEAST-SQUARES REFINEMENT AT HIGH SPEED. P.H.Friedlander, W.Love and D.Sayre.
Acta cryst., Vol. 8, Pt. 11, 732 (Nov., 1955).

Outlines a method for use with the IBM 701 computer, with notes on its application to a non-centrosymmetric structure with 20 atomic coordinates. A.R.Stokes

548.735

4103. METHOD OF REPRESENTING PREFERRED ORIENTATION DATA. L.K.Jetter, C.J.McHargue and R.O.Williams.
J. appl. Phys., Vol. 27, No. 4, 368-75 (April, 1956).

For the fibre-texture type of preferred orientation, a method is developed for determining the "fibre axis density" from the "pole density" given by X-ray diffraction data. The fibre axis distribution so deduced gives directly and quantitatively the type and degree of preferred orientation — the more preferred crystallographic directions of the fibre axis, the symmetries of the orientation distribution about the preferred directions, and the relative volumes of material associated with the various components. The procedure is demonstrated for extruded aluminium rod. The method is adapted to the study of the sheet-texture type of preferred orientation and applied in determining the textures in cold-rolled 65-35 brass and 2S aluminium sheet. A.

548.735

4104. METHOD FOR THE STUDY OF LATTICE INHOMOGENEITIES COMBINING X-RAY MICROSCOPY AND DIFFRACTION ANALYSIS. S.Weissmann.
J. appl. Phys., Vol. 27, No. 4, 389-96 (April, 1956).

An X-ray diffraction method has been developed which establishes a direct correlation between the spot reflections on the Debye–Scherrer lines and the lattice regions on the specimen surface giving rise to these reflections. After this correlation has been accomplished an analysis of the spot reflections based on the double diffractometer principle is carried out. The method applied to the study of the substructure of metals and alloys discloses the coexistence of various orders of magnitude of substructural entities. The determination of size, disorientation, and lattice misalignment for the various orders of substructural entities is shown and the nature of the small-angle boundaries is investigated. The general applicability of the method to various research problems is briefly discussed. A.

548.735.4 : 535.42

4105. NOTE ON A REFLECTING OPTICAL DIFFRACTION SPECTROMETER. A.Elliott and P.Robertson.
Acta cryst., Vol. 8, Pt 11, 736 (Nov., 1955).

The two lenses in the usual apparatus (Abstr. 5209/1953) are replaced by a concave spherical mirror of diameter 17 cm and radius of curvature 10 m. A.R.Stokes

548.735.44

4106. A NEW GRAPHICAL PRINCIPLE FOR THE EVALUATION OF FOURIER TRANSFORMS. H.J.Grenville-Wells.
Acta cryst., Vol. 8, Pt 11, 737 (Nov., 1955).

The structure factors at non-integral and integral h and k values can be calculated by graduating a square [001]-projection of the unit cell with a sine or cosine function, and drawing constant k-charts. C.Turner

548.736.1 : 539.133

4107. THE CRYSTAL AND MOLECULAR STRUCTURE OF ORTHORHOMBIC SULFUR. S.C.Abrahams.
Acta cryst., Vol. 8, Pt 11, 661-71 (Nov., 1955).

548.736.3

4108. THE STRUCTURE OF $MoBe_{12}$. R.F.Raeuchle and F.W.von Batchelder.
Acta cryst., Vol. 8, Pt 11, 691-4 (Nov., 1955).

The structure of $MoBe_{12}$ has been determined. Formal valences of 3.36 for molybdenum and 1.85, 2.27 and 2.59 for beryllium have been calculated using Pauling's single-bonded metallic radii, and are interpreted in terms of electron shift. A.

548.736.4

4109. THE CRYSTAL STRUCTURE OF $Na_{2-x}V_6O_{15}$. A.D.Wadsley.
Acta cryst., Vol. 8, Pt 11, 695-701 (Nov., 1955).

548.736.4

4110. COMPARATIVE STUDY OF CRYSTAL STRUCTURES OF FERRITES OF LANTHANUM, PRASEODYMIUM AND SAMARIUM. G.Guiot-Guillain.
C.R. Acad. Sci. (Paris), Vol. 242, No. 6, 793-5 (Feb. 6, 1956). In French.

These ferrites show the perovskite structure in their powder patterns (see Abstr. 6592/1951), but with varying numbers of extra lines, so far unexplained. A.R.Stokes

548.736.4 : 538.24

111. STRUCTURE OF FERRIMAGNETIC FERRITES OF RARE EARTHS. F.Bertaut and F.Forrat.
C.R. Acad. Sci. (Paris), Vol. 242, No. 3, 382-4 (Jan. 16, 1956). In French.

The authors do not accept Néel's theory (Abstr. 9381/1954) of the spontaneous magnetization of perovskite-type compounds. They put forward a new structure with a cubic unit cell of side 2.44 A containing eight units of 5 Fe_2O_3.3 Gd_2O_3. A.R.Stokes

548.74

112. ON THE SUPERSTRUCTURE OF THE ORDERED ALLOY Cu_3Pd. I. ELECTRON DIFFRACTION STUDY. H.Watanabe and S.Ogawa.
J. Phys. Soc. Japan, Vol. 11, No. 3, 226-39 (March, 1956).

Ordered structures of copper—palladium alloys, chiefly of a'' phase (18—28 atomic % Pd) were investigated by electron diffraction, using oriented evaporated films. The elucidated structure of the a'' phase can be thought of as formed from the elementary face-centred tetragonal lattice, in which the atoms arrange themselves as in the ordered lattice of Cu_3Au but the two kinds of step-shift occur at every definite distance along two directions parallel to the crystallographical axes, respectively. Thus, a two-dimensional anti-phase domain structure results, which is considered to have a large orthorhombic unit cell. The present model seems to be connected, not with that proposed by Geisler and Newkirk, but closely with that proposed by Schubert et al. A.

GEOPHYSICS 55

551.465 : 551.513

113. EQUATIONS OF MOTION OF THE OCEAN AND ATMOSPHERE. C.Eckart and H.G.Ferris.
Rev. mod. Phys., Vol. 28, No. 1, 48-52 (Jan., 1956).

The density of the air in the atmosphere, or of the water in the ocean, is a function of altitude or depth. Linear equations for the motion of such stratified fluids have been derived by many authors. Many have introduced simplifying assumptions into their derivations, with the result that it is difficult to compare one paper with another. The present review is a collection of the major systems of equations, in a uniform notation. The derivations given are those which bring out the interrelations of the various systems, and are sometimes quite different from those of the original papers. The solution of the equations is not discussed, so that the relative merits of the various systems cannot be evaluated. A.

ATMOSPHERE. METEOROLOGY 551.5

551.510.41

114. THE AERONOMIC PROBLEM OF NITROGEN OXIDES. M.Nicolet.
J. atmos. terrest. Phys., Vol. 7, No. 3, 152-69 (Sept., 1955).

From consideration of the observational data on atmospheric nitric oxide, it is found that its concentration at any height must be less than 10^{11} cm^{-3}. Theoretical deductions from an aeronomic study show that its concentration could be of the order of 10^8 cm^{-3} (or 5 x 10^8) at about 80 km, and 10^9 cm^{-3} (or 5 x 10^9) at about 65 km. At any height below 70 km the nitric oxide concentration must be less than the ozone concentration. The dissociation of nitrogen molecules involved in nitric oxide formation depends strongly on photoionization by ultraviolet or X-ray radiation and subsequent dissociative recombination. The vertical distribution of nitrogen atoms cannot be determined by a dissociation equilibrium, since it is subject to dynamical effects such as diffusion and atmospheric mixing. Whatever the process involved in the formation of nitric oxide, its vertical distribution will tend to follow the atmospheric distribution until it becomes dissociated. A departure from photo-equilibrium conditions cannot occur for nitrogen peroxide molecules, for their lifetime in a sunlit atmosphere is very short. Nitrous oxide seems to play no role in the mesosphere. In anticipation of the importance attached to the aeronomic problem of nitrogen oxides in the mesosphere and lower thermosphere, various provisional numerical data are presented. A.

551.510.534

115. NEW EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON THE ATMOSPHERIC OZONE LAYER. H.K.Paetzold.
J. atmos. terrest. Phys., Vol. 7, No. 3, 128-40 (Sept., 1955).

A summary is given of theoretical and experimental investigations on the atmospheric ozone layer carried out by the author, discussing the photochemical constitution of ozone, determination of the vertical zone distribution, dependence of ozone on the latitude, ozone household, annual ozone course, and ozone as indicator for the transport of air (circulation and mass exchange). A.

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE.
See also under "Electromagnetic waves and oscillations".
Decimal classification 538.566.3

551.510.535 : 523.78

4116. SOLAR ECLIPSES AND THE IONOSPHERE. Edited by W.J.G.Beynon and G.M.Brown.
London: The Pergamon Press (1956) 300 pp. (Supplement to the Journal of Atmospheric and Terrestrial Physics).

A symposium sponsored by the International Council of Scientific Unions Mixed Commission on the Ionosphere held at the Royal Society, London, 22-24 August, 1955. Opening survey and concluding summary by J.A.Ratcliffe. Abstracts of the papers will be published later.

551.510.535 : 621.396.11

4117. THE TECHNIQUE OF IONOSPHERIC INVESTIGATION USING GROUND BACK-SCATTER. E.D.R.Shearman.
Proc. Instn Elect. Engrs, Paper No. 1915 R, publ. Oct., 1955 (Vol. 103 B, 210-23, 232-5).

Republication, with discussion, of the paper abstracted in Abstr. 833 (1956).

551.513

4118. HEAT CONVECTION FROM THE EARTH'S SURFACE. C.H.B.Priestley.
Nature (London), Vol. 177, 435-6 (March 3, 1956).

The view that a regime of effectively free convection of heat begins to operate in the surface layers of the atmosphere at a negative Richardson number of 0.02 or 0.03 is examined and it is thought that regular cellular convection of the type studied by Rayleigh and elaborated by Malkus is improbable. It is shown that free convection can begin to operate at quite small Richardson numbers and to take initially the planar form with orientation downwind with an increasing proportion of columnar forms as $-Ri$ increases. Measurements of heat flux have indicated that the complete transformation from forced to free convection may take place much more sharply than previously supposed. Close to the ground will be a layer where forced convection is dominant provided some wind is blowing.

But above the level at which the effects of free convection begin to be felt, there will be a strong bias towards the 4/3 power law which allows free convection to dominate. R.S.Read

551.593.9 : 535.33

4119. INFRARED SPECTRUM OF THE NIGHT SKY FROM 1.0 μ TO 2.0 μ. H.P.Gush and A.V.Jones.
J. atmos. terrest. Phys., Vol. 7, No. 4-5, 285-91 (Oct., 1955).

The spectrum of the night sky from 1.0 to 2.0 μ has been obtained, using a scanning spectrometer equipped with a PbS cell detector. The spectral slit width employed varies from 100 A to 200 A. It has been concluded, from a comparison with synthetic spectra, that the observed spectrum must arise predominantly from the rotation–vibration bands of the OH molecule. A.

551.594.14 : 621.359 : 621.319.7

4120. APPLICATION OF THE ELECTROSTATIC PRECIPITATOR TO THE MEASUREMENT OF RADIOACTIVE AEROSOLS. B.A.Bergstedt.
J. sci. Instrum., Vol. 33, No. 4, 142-8 (April, 1956).

A continuous air monitor and a portable dust sampler are described both using a new type of electrostatic precipitator. In the continuous air monitor, the dust is collected on a moving aluminium tape which then passes the radiation dectors. The precipitator is operated at very low efficiency, giving a high sensitivity which is nearly independent of air flow rate. The effective drift velocity of the particles towards the collection surface is more than ten times that in the Cottrell-type precipitator. A.

551.594.221 : 621.396.11

4121. RADIO REFLECTION FROM LIGHTNING. V.A. Baranul'ko and I.V.Fedotov.
Radiotekhnika, Vol. 10, No. 11, 80 (1955). In Russian.

Very intense reflections of short duration (about 1 s) from lightning discharges distant 5 to 150 km were observed, during the summer 1954, by means of a 1.5 m radar equipment having a range of 160 km. The reflections are attributed to the column of ionized particles, which is formed during an atmospheric discharge. R.S.Sidorowicz

551.594.51

4122. SOME PHOTOMETRIC OBSERVATIONS OF AURORAL SPECTRA. D.M.Hunten.
J. atmos. terrest. Phys., Vol. 7, No. 3, 141-51 (Sept., 1955).

A variety of measurements of auroral spectra has been made with a photoelectric spectrometer. These include relative and absolute intensity measurements of the more prominent features,and a verification of Seaton's absolute intensity scale. Observations of Hβ seem to indicate more erratic behaviour than has been assumed. The intensity of the N II lines 5001-5 A shows little or no excitation by helium ions. A very intense feature observed in Type B red aurora appears to be due to sodium. The vibrational development of the N_2^+ first negative system indicates electron excitation from the ground state of N_2 at a temperature of 0-700°K. The results show the spectrometer to be useful for intensity measurement and the observation of short-lived effects. It is, however, limited to the brighter forms of aurora. A.

551.596.1

4123. GEOMETRICAL THEORY OF SOUND PROPAGATION IN THE ATMOSPHERE. G.V.Groves.
J. atmos. terrest. Phys., Vol. 7, No. 3, 113-27 (Sept., 1955).

Deals with the geometry of sound waves and rays propagated in a moving inhomogeneous medium with particular reference to the atmosphere. The theory developed is, essentially, a generalization of that in geometrical optics for the propagation of light in an inhomogeneous isotropic medium to the case where the medium is in motion. Differential equations defining the wavefront and rays of a sound propagation in an inhomogeneous moving medium are derived, and then transformed by expressing the unit normal of the wavefront in terms of certain trace velocities. With the equations in this form, an integral is immediately obtainable for sound propagated in the atmosphere by assuming that the velocity of sound and wind-velocity vector are functions of height only. From this solution the law of refraction, the condition for total reflection of a sound ray, and the equations for the wavefront at any time are found. By way of example, the theory is applied to a simple velocity of sound v. height relation, and expressions are obtained for the range and time at which the abnormal propagation from a ground-level source returns to earth. Numerical results calculated from these formulae are found to be in accord with observations that have been made on this phenomenon. A.

BIOLOGY 57/59

578.087.9 : 621.317.79

4124. AN INSTRUMENT FOR MEASURING RESPIRATORY RATES AND VOLUMES. W.Nisbet.
J. sci. Instrum, Vol. 33, No. 4, 154-8 (April, 1956).

Fluctuating flow-rates, total flow volumes and the frequency of an alternating flow are measured by an instrument which has been used in respiration studies on the calf. The instrument consists of three units, (1) a flow-sensing unit in the form of a fine mesh gauze used under laminar flow conditions; (2) a magnetic induction manometer associated with an amplifier-detector and an oscillator and (3) an electronic integrator. The flow-rate/pressure relationship of the gauze is practically linear; ± 3.5 litres/sec giving a pressure drop of ± 1.25 mm of water. The amplifier-detector output is ± 9 V, d.c. for a pressure of ± 1.5 mm water; the linearity of the complete manometer is within 1%. The integrator accuracy is normally ± 2½% of full scale on all 8 ranges between 0.5 and 0-400 litres. Steady flow-rates and total flow are indicated on a 5 in. scale panel meter and instantaneous flow-rates on an external oscilloscope. Integration time is controlled by an electric clock movement and each flow alternation is recorded on an electromagnetic counter. A.

578.088.2

4125. PRODUCTION OF LESIONS IN THE CENTRAL NERVOUS SYSTEM WITH FOCUSED ULTRASOUND: A STUDY OF DOSAGE FACTORS. T.F.Hueter, H.T.Ballantine, Jr and W.C.Cotter.
J. Acoust. Soc. Amer., Vol. 28, No. 2, 192-201 (March, 1956).

Applications of ultrasonics in neurosurgery involve the production of lesions of a specified size at a specified location, and in a reproducible fashion. Control of the dosage required for a given lesion depends on the geometry of the focal region, the exact determination of focal intensity and the relation between irradiation parameters and biological effect. From an analysis of these factors an optimum frequency for each focal depth is determined and an empirical dosage relationship based on ultrasonically produced paralysis in mice is stated. The mechanism of cell destruction by ultrasound is shown to be a temperature-dependent mechanical effect originating at weak points in the tissue. The difficulties in extrapolating results obtained with experimental animals to applications in human neurosurgery are pointed out. A

578.088.2

126. CHANGES IN ADRENALS AND OTHER ORGANS FOLLOWING EXPOSURE OF HAIRLESS MICE TO INTENSE SOUND. A.Anthony.
. Acoust. Soc. Amer., Vol. 28, No. 2, 270-4 (March, 1956).

Systemic effects in hairless mice were studied following ocal abdominal and scrotal skin exposure to intense air-borne ound. Comparisons were made between effects of moderately igh (150 db, 18 kc/s) and high (160-168 db, 20 kc/s) levels of ound. Examination of control mice revealed that 10 min daily mmobilization for one to three months was sufficiently stress-ul to cause an hypertrophy of the adrenal cortex and involution f the thymus. Evidence was also obtained which indicated there as an increased adrenal response in immobilized mice which ere exposed to moderately high levels of sound for periods of ne to three months. it was concluded from these studies that mmobilization and sound vibrations on the skin surface can oth be considered stressful. The absence of gonadal damage nd slight changes in the hemopoietic system indicated these re mild rather than severe stress stimuli. In other experi-nents where more intense sound was used, the local and sys-emic response was similar to that known to occur following rdinary skin burns. In these cases heat and not sound was the tressor agent involved. A.

MEDICAL SCIENCE. HUMAN PHYSIOLOGY 61

612.843

127. STABILIZED INTERFERENCE FRINGES ON THE ETINA. R.W.Ditchburn and R.M.Pritchard.
lature (London), Vol. 177, 434 (March 3, 1956).

A cell consisting of a piece of calcite cemented between wo pieces of "Polaroid" is attached to a contact lens. Conver-ent light passing through the cell produces a pattern of rings nd brushes on the retina of an unaccommodated emmetropic ye. The pattern fades after 1-5 sec but reappears after 10 sec hen the eye has made a sharp movement. When the light is uitably flickered no fade-out occurs. R.A.Weale

612.843.613

128. MEASUREMENTS OF DIFFERENTIAL THRESHOLD IN THE PRESENCE OF A SPATIAL ILLUMINATION GRADIENT. .Fiorentini, M.Jeanne and G.Toraldo di Francia.
tti Fond. Ronchi, Vol. 10, No. 5, 371-9 (Sept.-Oct., 1955).

A field where the luminance varies along a given direc-ion is viewed by an observer and the photometric differential threshold is measured in different points of the field. The experimental values of the threshold compare fairly well with the distribution of subjective brightness, as reported by the observer. It has been found that the presence of the gradient of illumination makes the threshold increase. The value of the threshold at the point of the field where the bright Mach band is seen by the observer, decreases when the angular width of the graded field increases. This variation qualitatively corresponds to the decrease of brightness of the Mach band. A.

612.843.613

4129. A STATISTICAL INFORMATION THEORY OF VISUAL THRESHOLDS. R.L.Gregory and V.Cane.
Nature (London), Vol. 176, 1272 (Dec. 31, 1955).

Ricco's and Piper's laws are derived as special cases of a relation connecting the differential sensitivity and stimulus area. The treatment is based on the statistics of information channels. R.A.Weale

612.843.72

4130. CONCEPT OF DISTANCE IN AFFINE GEOMETRY AND ITS APPLICATIONS IN THEORIES OF VISION. H.von Schelling.
J. Opt. Soc. Amer., Vol. 46, No. 5, 309-15 (May, 1956).

In Euclidean spaces of an arbitrary number n of dimensions metrics are defined which are invariant with respect to affine transformations of the coordinates. These metrics are closely related to non-Euclidean distances in spaces of negative constant curvature. Special cases are discussed. The logarithmic scale results for n = 1. The case n = 2 occurs in the solution of a colorimetric problem. The most important case n = 3 is connected to the colour space and to Luneburg's geometry of the space of binocular vision. A.

612.85 : 534.321

4131. NOTE ON THE OBSERVATION OF THE TARTINI PITCH. J.Sandstad.
J. Acoust. Soc. Amer., Vol. 27, No. 6, 1226 (Nov., 1955).

Reference is made to papers by M.F.Meyer (Abstr. 9863/1954, 699-70/1955) which describe experiments using a combination of two sinusoidal tones to stimulate the ear, and observed subjective tones the pitch of which did not correspond to any harmonic of the original frequencies nor to the sum or difference of them. The present note offers another possible explanation of these observations. He considers that the subjective tones observed by M.F.Meyer may be explained by the assumption of a nearly symmetric nonlinearity in the mechanical transmission of sound in the ear. In such a case the combination frequency ($2f_2 - f_1$) will be louder than the sum and difference frequencies ($f_1 \pm f_2$). A.B.Wood

TECHNIQUE. MATERIALS 62/69

669 : 548.5

4132. FLOATING ZONE MELTING OF SOLIDS BY ELECTRON BOMBARDMENT. M.Davis, A.Calverley and R.F.Lever.
. appl. Phys., Vol. 27, No. 2, 195-6 (Feb., 1956).

The solid rod is held in chucks in an evacuated enclosure Abstr. 5195/1953) and the liquid zone is melted by bombardment by electrons accelerated by a few kV towards the rod rom a heated pure W filament. The molten zone may be made o traverse the length of the rod by relative motion between od and filament assembly. Suitable for refractory materials. S.Weintroub

PHOTOGRAPHY 77

77.02

4133. DRYING OF NUCLEAR PHOTOGRAPHIC EMULSIONS BY TEMPERATURE GRADIENT. R.Rechenmann.
J. Phys. Radium, Vol. 17, No. 2, 163-4 (Feb., 1956). In French.

The sample is placed on a lower hot element, a similar cooled element arranged about 20 cm above, and the whole enclosed in a box. Convection currents give rapid, even and dust-free drying. S.T.Henderson

771.5

4134. VARIATION OF DIMENSIONS, AS A FUNCTION OF EXPOSURE, IN THE PHOTOGRAPHIC IMAGE OF A CRACK WITH A DIFFUSE EDGE. M.T.Vigón and M.A.Olagorta.
An. Real. Soc. Espan. Fís. Quím., Vol. 51 (A), No. 9-10, 193-214 (Sept.-Oct., 1955). In Spanish.

Frieser's equation for the distribution of light on a photographic emulsion is used to determine the shape of the dimension curve (dimension against logarithm of the exposure) of the developed image of a crack with a diffuse edge. It satisfactorily agrees with the experimental curve. The previously found turbidity coefficient increases with the contrast of the image and is related to the spectral composition of the light. This relation is independent of the absorption and diffusion of the light in the emulsion, which is believed to be due to the spectral sensibility of the material. A.

771.53

4135. MEASUREMENT OF THE SIZE OF GRAINS IN NUCLEAR EMULSIONS BY THE "ENVELOPE" METHOD. C.Gegauff and J.Boissier.
J. Phys. Radium, Vol. 17, No. 2, 162-3 (Feb., 1956). In French.

The distribution of AgBr grain size in Ilford G5 emulsion has been determined by electron microscopy. The electron beam causes decomposition of the grains but renders their original outlines visible by an envelope of decomposition products. From the photograph the projected areas of grains are measured by weighing cut-outs on an enlarged image. The method may be applicable to the study of photographic fixation. S.T.Henderson

771.534.55

4136. CONCLUSIONS FROM THE CHARACTERISTIC CURVES OF PHOTOGRAPHIC PLATES, MINIMUM EFFECT OF GRAIN. O.Oldenberg.
J. Opt. Soc. Amer., Vol. 46, No. 4, 300-2 (April, 1956).

By a consistent argument, based on the characteristic curves of photographic plates, the optimum conditions for the following spectrographic problems are derived: weak emission line without background; weak absorption line; weak emission line on a given continuous background; prefogging; measurement of relative intensities. The effect of the grain on the resolving power is minimized by averaging over the length of the line. This technique gives to the very sensitive plate (Kodak type I-O), in spite of its coarse grain, the same high resolving power as that of a very fine grain plate which requires 90 times longer exposure. A.

771.534.55

4137. RESOLVING POWER OF PHOTOGRAPHIC EMULSIONS. P.Hariharan.
J. Opt. Soc. Amer., Vol. 46, No. 5, 315-23 (May, 1956).

The resolution characteristics of typical panchromatic negative films have been studied with a camera using microscope objectives. The results are presented of resolution measurements made with high and low contrast line targets and low contrast annulus targets, over a range of development times. Measurements were also made of the speeds of these films on the resolving power criterion. These show that the resolving power speed increases linearly with the gamma. The ratio of the minimum exposure permissible on the fractional gradient criterion to the exposure based on the resolving power criterion varies with the brightness scale of the subject. A.

771.535

4138. CHANGES IN THE LATENT IMAGE BEFORE DEVELOPMENT. II. EFFECT OF A SECOND EXPOSURE. M.T.Vigón and J.de Paul.
An. Real Soc. Espan. Fís. Quím., Vol. 51 (A), No. 11-12, 237-56 (Nov.-Dec., 1955). In Spanish.

For PtI, see Abstr. 677 (1955). The suggestion has been made that the change is due to the tendency of the latent image to reach an equilibrium. A formula is proposed which shows the efficiency of double exposure in relation to a continuous exposure of identical magnitude. A.

771.535

4139. CHANGES IN THE LATENT IMAGE BEFORE DEVELOPMENT. III. EXPERIMENTAL CONFIRMATION BASED ON THE DENSITY VARIATION. M.T.Vigón and M.A.de la Vega.
An. Real Soc. Espan. Fís. Quím., Vol. 52 (A), No. 1-2, 11-26 (Jan.-Feb., 1956). In Spanish.

An equation which relates the density variations and the time between the exposure and the development has been drawn. The relation is in agreement with the facts described in the literature and leads to conclusions relating the influence of certain factors on the observed density variation. A.

778.34

4140. ON THE PARTICLE/γ-DISCRIMINATION IN THE METHOD OF (NUCLEAR) PARTICLE PHOTOGRAPHY. P.Cüer and H.Braun.
C.R. Acad. Sci. (Paris), Vol. 242, No. 4, 486-9 (Jan. 23, 1956). In French.

The ideas of Cüer and Schmitt (Abstr. 9329/1955), have been applied on the granular dispersion of the latent images formed in emulsion by different radiations. With Ilford 50μ C2 and E1 emulsions, by suitable development and intensification techniques, α and proton tracks can be distinguished against a γ-ray background of 30 000 r intensity or against a background of fast β-particles of an intensity of the order of $2 \times 10^{11}/cm^2$. D.J.Prowse

778.34

4141. IONIZATION MEASUREMENTS ON STEEP TRACKS IN NUCLEAR EMULSION. H.Winzeler.
Helv. phys. Acta, Vol. 28, No. 5-6, 497-502 (1955). In German.

It is possible to easily determine the ionization of very steeply dipping tracks on the basis of the method of 'mean-gap-length' by the use of a simple correction. This correction has been estimated and it is fully discussed. The results have been verified by means of measurements on two steep high-energy α-particles. D.J.Prowse

778.34

4142. AN AUTOMATIC SCANNER FOR NUCLEAR EMULSIONS. S.J.Goldsack and H.B.van der Raay.
J. sci. Instrum., Vol. 33, No. 4, 135-8 (April, 1956).

A photoelectric method of obtaining the angular distributio of tracks in nuclear emulsions is outlined. Details of the apparatus constructed and its performance are given. The angu lar resolution is about $\frac{1}{2}^\circ$ and the apparatus can be made to accept tracks of minimum grain density. A.

778.34 : 539.11 : 539.17 : 539.2

4143. APPLICATION OF HIGH MAGNETIC FIELDS TO NUCLEAR TRACK ANALYSIS AND SOLID STATE RESEARCH. H.P.Furth and R.W.Waniek.
Nuovo Cimento (Ser. 10), Vol. 2, No. 6, 1350-2 (Dec., 1955).

Very high transient magnetic fields have been applied to nuclear track plates. A 3000 V capacitor bank discharges 7800 joules through a variable pulse transformer into a pair of Helmholtz coils in a time of 1-10 msec. The coils operate at liquid nitrogen temperatures at 160 000 gauss. The charge–discharge is capable of synchronization with a particle acceler ator. Fields up to 650 000 gauss over 100 mm^3 have been attained. Plates exposed to a 95 MeV proton beam at liquid nitrogen temperatures have shown normal grain densities and little distortion. The uses of such very high fields in nuclear emulsion technique and solid-state physics are discussed. D.J.Prowse